

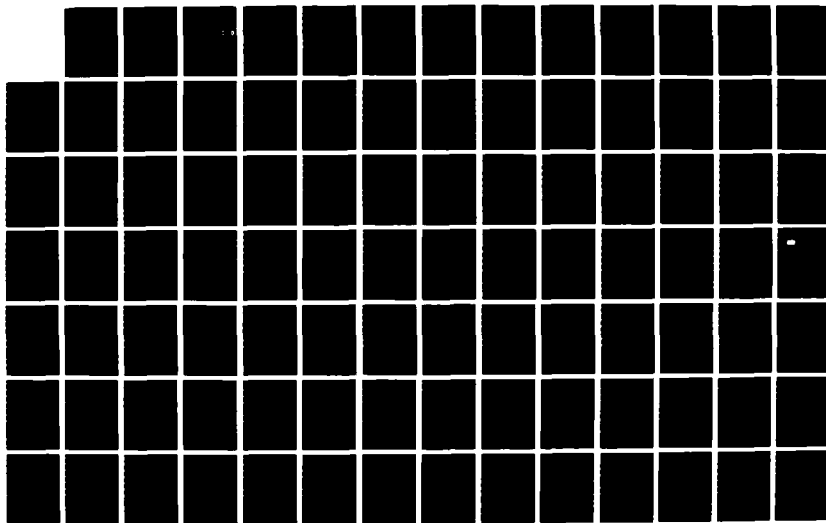
NO-A187 836

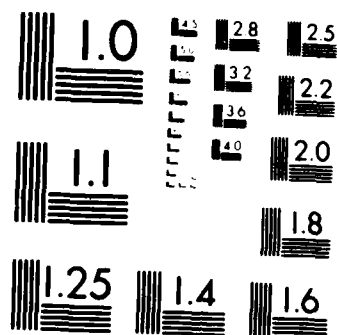
AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN  
FACILITIES ENGINEERING(U) AIR FORCE INST OF TECH  
WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. D M KREAG  
SEP 87 AFIT/GEN/LSM/875-14 F/G 5/6

1/2

UNCLASSIFIED

NL



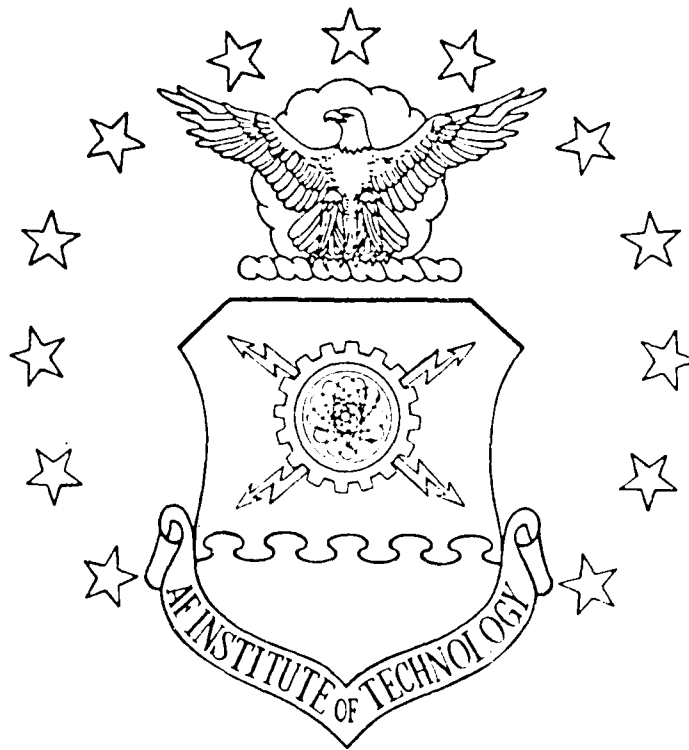


MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

DTIC FILE COPY

Ci

AD-A187 836



DTIC  
ELECTE  
JAN 04 1988  
S H

AN INVESTIGATION OF EDUCATIONAL  
REQUIREMENTS IN FACILITIES ENGINEERING  
THESIS

DAVID M. KREAG  
Captain, USAF

AFIT/CDM/CDM/87-11

DEPARTMENT OF THE AIR FORCE  
AIR UNIVERSITY  
**AIR FORCE INSTITUTE OF TECHNOLOGY**

Wright-Patterson Air Force Base, Ohio

DISTRIBUTION STATEMENT A

Approved for public release;  
Distribution Unlimited

87 12 22 035

AFIT/GEM/LSM/87S-14

DTIC  
ELECTE  
JAN 04 1988  
H

AN INVESTIGATION OF EDUCATIONAL  
REQUIREMENTS IN FACILITIES ENGINEERING

THESIS

DAVID M. KREAG  
Captain, USAF

AFIT/GEM/LSM/87S-14

Accession For	
NTIS GRA&I	<input checked="checked" type="checkbox"/>
DTIC TAB	<input type="checkbox"/>
Unannounced	<input type="checkbox"/>
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A-1	

Approved for public release; distribution unlimited

The contents of the document are technically accurate, and no sensitive items, detrimental ideas, or deleterious information is contained therein. Furthermore, the views expressed in the document are those of the author and do not necessarily reflect the views of the School of Systems and Logistics, the Air University, the United States Air Force, or the Department of Defense.

AFIT/GEM/LSM/87S-14

AN INVESTIGATION OF EDUCATIONAL  
REQUIREMENTS IN FACILITIES ENGINEERING

THESIS

Presented to the Faculty of the School of Systems and Logistics  
of the Air Force Institute of Technology

Air University

In Partial Fulfillment of the  
Requirements for the Degree of  
Master of Science in Engineering Management

David M. Kreag, B.S.

Captain, USAF

September 1987

Approved for public release; distribution unlimited

### Acknowledgments

I wish to express my love and appreciation to my wife, Eleanor, for her patience and understanding throughout this academic year.

A special thanks is extended to Mr. Tom Klug, Director of Association Development for the AIPE Foundation, who paved the way for the nominal support of the research by the Foundation and provided me with a mailing list to survey the civilian respondents. Also, I appreciate the time spent on the survey by the civilian and military respondents.

Finally, I thank Maj. Hal Rumsey, my thesis advisor, and Dr. Robert Weaver, my thesis reader, for their time, expertise, and guidance in making this thesis possible.

David M. Kreaag

## Table of Contents

	Page
Preface . . . . .	ii
List of Tables . . . . .	v
Abstract . . . . .	vi
I. Introduction . . . . .	1
Background . . . . .	1
Specific Problem . . . . .	3
Definition of Terms . . . . .	3
Research Questions . . . . .	4
Scope . . . . .	5
II. Literature Review . . . . .	6
Introduction . . . . .	6
Background . . . . .	6
Educational Programs . . . . .	7
Program Assessment . . . . .	7
Comparison of Subject Matter . . . . .	8
Summary . . . . .	11
III. Methodology . . . . .	12
Introduction . . . . .	12
Interviews . . . . .	12
Academic Subject Generation . . . . .	13
Survey . . . . .	13
Survey Development . . . . .	13
Population and Sample . . . . .	16
Data Collection Plan . . . . .	18
Research Question #1 . . . . .	18
Research Question #2 . . . . .	19
Research Question #3 . . . . .	19
Research Question #4 . . . . .	19
Analyses . . . . .	21
IV. Results . . . . .	22
Introduction . . . . .	22
Demographic Results . . . . .	22
Research Question #1 . . . . .	28
Research Question #2 . . . . .	28
Research Question #3 . . . . .	31
Research Question #4 . . . . .	33



	Page
V. Discussion and Conclusions . . . . .	35
Introduction . . . . .	35
Demographics . . . . .	35
GEM Program . . . . .	36
Previous Survey Results . . . . .	36
Improvement to Program . . . . .	36
Existing GEM Subjects . . . . .	39
Potential GEM Inclusions . . . . .	39
Summary . . . . .	40
Appendix A: Information Request Letter . . . . .	42
Appendix B: Organizations Contacted . . . . .	43
Appendix C: Survey Package for Civilian Sample . .	44
Appendix D: Survey Package for Military Sample . .	56
Appendix E: AFIT Data Collection Form . . . . .	68
Appendix F: GEM Course Titles . . . . .	70
Appendix G: Responses to the Three Questions (By Military Rating) . . . . .	71
Appendix H: Importance and Need Ratings of Academic Subjects (By Military Rating) . . . . .	73
Appendix I: T-test . . . . .	75
Appendix J: Programs and Data . . . . .	77
Bibliography . . . . .	99
Vita . . . . .	101

## List of Tables

Table	Page
I. Facility Management Programs . . . . .	8
II. Required & Elective Courses . . . . .	9
III. Academic Subjects . . . . .	14
IV. Responses by Position . . . . .	23
V. Responses by Rank . . . . .	24
VI. Responses by Type of Company . . . . .	24
VII. Responses by Experience . . . . .	25
VIII. Responses by Education . . . . .	26
IX. Responses by Civilian Undergraduate Education .	27
X. Responses by Budget . . . . .	27
XI. Responses to the Three Questions by Category .	29
XII. Importance & Need Ratings of Academic Subjects (By Military Rating) . . . . .	30
XIII. Need & Importance by Category . . . . .	31
XIV. Academic Subjects Rated Significantly Higher by Civilians . . . . .	33
XV. Academic Subjects Rated Important by Either Military or Civilian Respondents . .	37

Abstract

This research identified academic subjects considered important by facility managers in order to improve the Air Force's educational program on facility management. From the literature review, 59 academic subjects were incorporated into a survey to test for perceived need and importance. Two populations of facility managers were surveyed to compare military and civilian perspectives, using a 7-point Likert scale.

The results indicated that professional ethics was the single most important subject. Construction management, life cycle costing, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking were rated with means above 5 (important) by both military and civilian respondents. Seventeen other academic subjects were rated by either the military or civilian respondents as important. Of the 59 academic subjects, 35 (59%) showed no significant differences between the means of the military and the civilian respondents.

Twelve academic subjects not specifically included in the Air Force's Graduate Engineering Management curriculum were considered important by either the military or the civilian respondents: professional ethics, construction management, strategic planning, maintenance management,

budget preparation, building fire protection, building programming, civil engineering, mechanical engineering, electrical engineering, safety engineering, and value engineering. Inclusion of these academic subjects may improve the overall program. They could be incorporated into already existing courses, or made available as additional elective courses in the GEM curriculum.

# AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN FACILITIES ENGINEERING

## I. Introduction

This research will examine the perceptions of need and importance of academic subjects by both civilian and military facility managers. By comparing civilian facility managers' perceptions to the military's views, an insight may be gained for improvement in the facilities engineering program. The following sections discuss the background, specific problem, definition of terms, research questions, and scope of this research.

### Background

The civil engineering officer is the Air Force's facility manager. Private sector facility managers do much the same thing for a company as civil engineering officers do for the Air Force. Both Air Force and private sector facility managers are responsible for maintenance of commercial and industrial type facilities, although the types of facilities may differ between the Air Force and the private sector due to location and mission.

The mission of the Air Force Civil Engineer is to "support . . . the Air Force mission and its people . . . [through the] operation, maintenance, and improvement of Air Force real and installed properties" (4:9). The civil

engineer manages the maintenance and repair of all base facilities and real property installed equipment, as well as the design and construction of new facilities.

A look at the mission of civilian facility managers reveals that indeed there are similarities. Examples of typical mission statements from three different private sector firms are as follow:

1) At Digital Equipment Corporation, the

plant engineer's major functions include maintenance of facilities and equipment, construction, and space planning. (8:28)

2) The Nissan motor plant near Smyrna, Tennessee, has its plant engineering department organized under three responsibility areas:

Plant energy systems, which includes plant utilities and plant systems . . . .

Central services, which includes maintenance planning and control, central maintenance, and environmental engineering . . . .

Engineering design and construction, which includes facilities engineering and construction projects. (20:58)

3) Plant Engineer Glen E. Flook, head of Frito-Lay's Casa Grande, Arizona, Engineering and Technical Services group said:

We operate the plant waste water treatment system, boilers, utilities, and fire protection systems; provide technical support; and keep all the maintenance records. (15:49)

All of the above private sector facility management job descriptions are similar in scope to what the civil engineering officer does on an Air Force base. Only three mission statements were listed to compare with the military mission statement; however, similar mission statements from private sector facility managers can be found in various periodicals on facility management.

#### Specific Problem

Since the private sector and the Air Force have similar mission statements covering facility management, they should rely on a common body of knowledge which might improve the Air Force's education program on facility management. Specifically, this research will focus on the academic subjects that private sector facility managers and civil engineering officers consider important for facility management. Individual educational programs will not be looked at. However, a compiled list of subject areas considered beneficial to the Air Force's educational program on facility management will be included.

#### Definition of Terms

1. Facility Manager--a person responsible for the management of the maintenance, repair, design, development, and construction of facilities and utility systems.

2. Plant Engineer--a person working in the private sector with the title of plant engineer conducting facility management type work.

3. Civil Engineering Officer--an Air Force officer with an Air Force Speciality Code of 55XX. Activities include "design and project preparation, drafting, surveying, planning, feasibility studies, construction surveillance, maintenance and repair, utilities operation, facility energy management, environmental control, land management, real estate and real property accounting, work measurement and analysis, and related installation support services" (5:A15-5).

4. GEM Program (Graduate Engineering Management)--the curriculum required to achieve a Master of Science degree in Engineering Management at the Air Force Institute of Technology (AFIT).

5. AIPE Foundation (American Institute of Plant Engineers)--the education and research arm of the American Institute of Plant Engineers.

#### Research Questions

1. What are some of the academic subjects in which facility managers have been educated?

2. Do facility managers perceive a need for these academic subjects?

3. What academic subjects are rated highly by civil engineering officers and/or private sector facility managers?

4. Are there differences in how private sector facility managers and Air Force civil engineering officers rate these academic subjects?



## Scope

The scope of this study follows these guidelines:

1) Academic subjects rather than the method of education will be focused upon. Academic subjects will include the knowledge, subjects, and abilities that facility managers see a need for in their jobs. The 59 academic subjects used are not an exhaustive list of all possible academic subjects that facility managers perceive as important.

2) A mailed survey was used, which limited the depth of knowledge gained from the study, and which also had a greater chance of misinterpretation than a personal or telephone interview.

3) The populations were limited to recipients of AIPE Facilities Management, Operations & Engineering magazine and past Air Force GEM students who graduated within the last five years. Samples from these populations were used to answer the research questions.

Ultimately, a list of subject areas considered important in the private sector was compiled so a comparison could be made with the Air Force's GEM program.

## II. Literature Review

### Introduction

This chapter will first give a general assessment of current education and training opportunities throughout all industries. Next, the Air Force's educational opportunities for civil engineering officers will be reviewed. Then a comparison will be made between the GEM, average American, average foreign, and International Facility Management Association (IFMA) curricula. Finally, a summary will explain how all of this information relates to the research.

### Background

It is a costly venture to educate personnel. Generally, companies pay at least 70 percent of the educational expenses for courses that an employee voluntarily attends (10:36). Eighty-one percent of the respondents of Training magazine's 1986 Industry Report indicated that organizations sponsor education and training of personnel in hopes that they will lead to better job performance. Management subjects, technical subjects, supervisory subjects, communication subjects, and new methods or procedural courses were the top five subject areas taught throughout all the industries surveyed in the report (12:57).

### Educational Programs

Air Force educational opportunities for facility managers include civilian institution graduate programs and a resident graduate degree program. The civilian institution graduate programs consist of engineering management and specific engineering areas such as architectural, civil, electrical, industrial, and mechanical (3:290). The resident graduate degree program for Air Force civil engineering officers is the GEM program at AFIT, which helps prepare the civil engineering officer for mid-level management positions in maintenance and repair of base facilities. Approximately 20-25 Air Force Officers per year attend the GEM program. This represents less than 2 percent of the lieutenants, captains, and junior majors in the civil engineering career field (19). Besides the GEM program, a range of professional civil engineering short courses is offered through the School of Civil Engineering and Services.

The GEM program at AFIT is not the only graduate level engineering management program. As of October 1984, 66 master of science level engineering management programs were offered at various colleges and universities in the United States (17:A-4).

Program Assessment. AFIT conducts two surveys annually to assess course effectiveness. One survey is the School of Systems & Logistics Annual Evaluation Report and the other

is the Graduate Post Course Survey. Fiscal year 1985 GEM students were surveyed upon course completion and asked which subjects they felt were important. The five subjects found to be the least important were operations research, statistical concepts, scientific research, accounting concepts, and evaluating distribution systems (1:69-70).

Comparison of Subject Matter. A comparison between the GEM, IFMA, and the average American and foreign engineering management curricula was made based on a 1984 paper on facility management disciplines presented at the International Congress on Technology and Technology Exchange. The average American and foreign engineering management curricula were divided into six categories (quantitative, qualitative, financial, project, engineering, and functional) as shown at Table I.

TABLE I  
FACILITY MANAGEMENT PROGRAMS

<u>Category</u>	<u>American</u>	<u>Foreign</u>	<u>IFMA</u>	<u>GEM</u>
Quantitative	30%	28%	17%	16%
Qualitative	19%	17%	29%	16%
Financial	15%	19%	12%	5%
Project	9%	5%	3%	14%
Engineering	4%	1%	0%	0%
Functional	23%	30%	39%	21%

(3:181-182, 14:A-III, 17:A10-11)

The GEM program shows 16 percent quantitative, 16 percent qualitative, 5 percent financial, 14 percent project, no engineering, and 21 percent functional.

Functional courses are those that pertain to the day-to-day operations of the job and do not fall within the other categories. The GEM program has a large project percentage because of the requirement for a thesis (14 percent). It also shows less emphasis in the financial percentage (5 percent) compared to the other programs. All three programs list the quantitative and functional areas with the highest percentages, which seems to support the idea that these two categories are the most important.

The percentages of required and elective courses of the curricula were also compared, as shown at Table II.

TABLE II  
REQUIRED & ELECTIVE COURSES

	<u>American</u>	<u>Foreign</u>	<u>IFMA</u>	<u>GEM</u>
Required	55%	82%	80%	82%
Electives	45%	18%	20%	18%

(3:181-182, 14:A-III, 17:A10-11)

The GEM program follows an 80 percent required 20 percent elective course program, like the foreign program. (See Appendix F.) The average American program offers a lower percentage of required courses (55 percent) and a higher percentage of electives (45 percent). This could be the result of the specific area coverage in the foreign and GEM courses. The GEM course is specifically designed for a civil engineering officer or civilian counterpart operating in the Air Force environment. The average engineering

management course in American programs probably offers more electives than the other programs due to more of a broad coverage that allows individuals to specialize in the areas that they are interested in rather than having to complete a required set of courses.

Facility management can be divided into its component parts. "Research has shown that 80-95 percent of facilities managers perform common tasks" (14:A-III). These nine common tasks are as follow:

- 1) Real Estate Acquisition and/or Disposal
- 2) Annual Facility Planning
- 3) Facility Financial Forecasting and Budgeting
- 4) Long Range Facility Planning
- 5) Interior Space Planning, Work-Place Specifications,  
Installation and Space Management
- 6) Architectural and Engineering Planning & Design
- 7) New Construction and/or Renovation Work
- 8) Maintenance and Operations Management of the  
Physical Plant
- 9) Tele-communications, Integration, Security, and  
General Administrative Services

(14:A-III)

Since these tasks are common to all facility managers, it would be expected that education in related subjects should be of major importance toward effective job performance.

### Summary

Education is a costly endeavor, but is conducted for better job performance. The Air Force, like most employers, pays educational costs to better prepare its employees. The civil engineering officer has many paths of education. There are the civilian institution program, resident GEM program, and AFIT's short courses. The GEM program is specifically designed for the civil engineering officer operating in the Air Force environment. There are many engineering management courses offered, some structured similarly to the GEM program. A comparison of other engineering management programs with the GEM program was conducted to search for improvements that may be incorporated. Specifically, academic subjects included in these engineering management programs were identified, to be incorporated into the survey which is described in the next section.

### III. Methodology

#### Introduction

This chapter describes the methodology used in the research. This research focuses on how private sector facility managers and civil engineering officers perceive various academic subjects in relation to their job performance. Ultimately, a list of academic subjects considered important by these groups will be compared.

#### Interviews

Mr. Tom Klug, the Marketing Manager for AIPE Facility Management, Operations & Engineering, sees the future trend on education of facility managers to be from general to more specific subjects (functional). According to Klug, employers have been burdened with educating new employees on specific job tasks. He predicts a shift to a more useful education with the merging of theory and reality in colleges and universities through the co-op programs. He also predicts that more qualitative management courses will be emphasized (16).

The Assistant GEM Program Manager compared the GEM program to a few other Engineering Management programs being taught at civilian institutions, and thought they were very similar. The only area where he saw a lack was in human behavior and people subjects (qualitative) (9).



### Academic Subject Generation

Letters were sent to various people and organizations involved with facility managers and plant engineers in the private sector. A copy of the letter and a listing of the organizations that responded to the letter are included at Appendices A and B. From their correspondence and from the literature, a list of academic subjects was compiled, as shown at Table III on the following page.

### Survey

The survey instrument was developed to collect data on what academic subjects were deemed important by facility managers. No existing data base was available for study. The survey method was chosen because it was the most economical method available for collecting the required data. Two separate surveys were conducted to gather information on the academic subjects which private sector facility managers and past AFIT Graduate Engineering Management students believe are important in their jobs. A random sampling method was used to obtain a representative sample of the private sector facility managers. A census of past GEM students (Air Force military members still in service who graduated within the last five years) was undertaken.

Survey Development. The development of the survey questions was based on previous work by Lyman W. Porter and Edward E. Lawler (18). Their methodology requires three

TABLE III

Academic SubjectsQuantitative

- |                        |                         |
|------------------------|-------------------------|
| 1) Linear Programming  | 2) Network Modeling     |
| 3) Simulation Modeling | 4) Decision Theory      |
| 5) Forecasting         | 6) Queuing Theory       |
| 7) Inventory Planning  | 8) Statistical Analysis |

Qualitative

- |                        |                           |
|------------------------|---------------------------|
| 9) General Management  | 10) Organizational Theory |
| 11) Behavioral Science | 12) Strategic Planning    |
| 13) Leadership         | 14) Personnel Management  |
| 15) Master Planning    |                           |

Financial

- |                           |                          |
|---------------------------|--------------------------|
| 16) Managerial Accounting | 17) Cost Accounting      |
| 18) Engineering Economy   | 19) Financial Management |
| 20) Budget Preparation    | 21) Building Programming |
| 22) Life Cycle Costing    |                          |

Project

- |                        |                    |
|------------------------|--------------------|
| 23) Project Management | 24) Group Projects |
|------------------------|--------------------|

Engineering/Architecture

- |                             |                              |
|-----------------------------|------------------------------|
| 25) Civil Engineering       | 26) Mechanical Engineering   |
| 27) Electrical Engineering  | 28) Industrial Engineering   |
| 29) Architectural Design    | 30) Interior Design          |
| 31) Computer Systems Design | 32) Safety Engineering       |
| 33) Value Engineering       | 34) Energy Efficient Designs |

Functional

- |                              |                             |
|------------------------------|-----------------------------|
| 35) Computer Science         | 36) Information Systems     |
| 37) Computer Aided Design    | 38) Computer Room Design    |
| 39) Communication            | 40) Public Speaking         |
| 41) Technical Writing        | 42) Business Law            |
| 43) Marketing                | 44) Quality Control         |
| 45) R & D Management         | 46) Innovation Techniques   |
| 47) Entrepreneur             | 48) Professional Ethics     |
| 49) Labor Relations          | 50) Collective Bargaining   |
| 51) Public Policy            | 52) Contract Policy         |
| 53) Building Fire Protection | 54) Real Estate Acq & Disp  |
| 55) Installation & Space Mgt | 56) Construction Management |
| 57) Maintenance Management   | 58) Facility Operations     |
| 59) Energy Management        |                             |

(2:A1-25+, 3:181-182, 14:A-III)

questions per academic subject. The first two questions are used to assess need, while the third assesses importance.

The survey questionnaire consists of subject areas which were assessed based on need, or the amount of difference between how much there is now and how much there should be. In addition, the importance of the subject was also measured. For each area, three questions were asked:

- a) How much are you able to apply now?
- b) How much should be applicable to your position?
- c) How important is this to you?

Need is calculated by subtracting the score of how much there should be from how much there is now ( $b - a$ ). A positive number indicates that a need is seen, while a negative number indicates that too much emphasis is placed on the subject; a zero indicates that there is a good balance in this area.

A 7-point Likert scale was used on each question, with a 1 as the minimum amount and a 7 as the maximum amount. The breakdown of the scale is as follows:

Minimum	Little	Less Than Average	Average	More Than Average	Great Deal	Maximum
1	2	3	4	5	6	7

A pretest was conducted in order to determine validity of the survey. Validity is the concept that the survey instrument is being interpreted by the respondents in the desired way and measures what is intended to be measured.

Eight AFIT faculty members from the School of Civil Engineering and Services responded to the questionnaire, examined it, and made comments for improvement. These people were selected due to their experience in civil engineering and with surveys. The "expert" review added to the credibility of the survey instrument to ask what was intended to be asked. Comments from the pretest were used to develop the final survey.

#### Population and Sample

The first population consists of the current recipients of the AIPE's periodical Facilities Management, Operations & Engineering. This group was chosen to represent the civilian facility managers due to their relative ease of inclusion. A larger group would have been desirable, but would have been too costly and time-consuming. The Business Publications Audit of Circulation, Inc., found that the number of recipients during the May/June issue was 8,173, 53.3 percent in manufacturing and 46.7 percent in non-manufacturing industries. Using this population, the sample size was determined from the following general formula:

$$n = \{N(z^2)(p(1-p))\} / \{1(N-1)(d^2) + (z^2)(p(1-p))\}$$

where    n= sample size  
          N= population size  
          p= maximum sample size factor (.50)  
          d= desired tolerance (10%)  
          z= factor of assurance (1.282) for 90% confidence level.

(13:11-14)

The maximum sample size factor is determined to be 0.50 because the true proportion to be estimated is not known. "To get around this difficulty, we shall make use of the fact . . . that  $p(1-p) = 1/4 - (p-1/2)^2$  and, hence, that the maximum value of  $p(1-p)$  is  $1/4$ ." (11:239) Hence, a conservative estimate of 0.50 is used when the true value of  $p$  is unknown.

The desired tolerance is determined prior to collection of data. The determination is based on how much error is acceptable. The error is the percentage of deviation either positive or negative from the actual population statistics. The factor of assurance is obtained by subtracting one minus ( $d$ ) and looking in the normal distribution tables to get ( $z$ ).

The sample size determined by the formula was 40.9. Two hundred surveys were sent to insure that the actual number returned would be 41 or greater. A 90 percent confidence level means that the statistics generated from the answers received are representative of the population, within a tolerance of plus or minus 10 percent (13:11).

The second population consisted of the military members still in service who graduated from the Air Force Institute of Technology GEM program within the last five years. Using this population of 115 military members, a census was conducted due to the small size of the population. Even though a census theoretically yields a 100 percent

confidence level, the previous general formula was used as a guide to determine adequacy of response to the census. Changing the population size to 115, a sample size of at least 31 would be enough for a 90 percent confidence level. This assumes that the 31 respondents are randomly selected, when in reality they are self-selected. Therefore, if 31 surveys are returned, at least a 90 percent confidence level would be achieved.

#### Data Collection Plan

The mailed survey packages consisted of a cover letter, 10-page survey, AFIT data collection form (AFIT Form 11 E, Jan 85), and a pre-addressed, postage-paid, return envelope (See Appendices C, D, and E). The military officers were given four weeks to respond, while the civilians had seven weeks to respond. The civilians were given longer to respond because of previous low responses to surveys.

The AFIT data collection forms were gathered up to 20 June 1987 including forms that contained incomplete data. Additional comments made by the respondents were collected and used in the analyses wherever feasible.

Research Question #1. What are some of the academic subjects in which facility managers have been educated? From the literature review, the average Engineering Management curriculum contains courses in six broad categories (quantitative, qualitative, financial, project, engineering, and functional). Subjects were then compiled

to be included in these six categories that were thought to be potentially important academic subjects of facility managers. With the assistance of the GEM Program Manager, 59 academic subjects were incorporated in the survey and were classified into the six broad categories mentioned above.

Research Question #2. Do facility managers perceive a need for these academic subjects? Means were calculated for each question (a, b, and c) and listed by academic subject and category. Then, need (b - a) was calculated for each academic subject and category.

Research Question #3. What academic subjects are rated highly by civil engineering officers and/or private sector facility managers? This research question was answered by rank ordering the academic subjects according to the importance of the two samples and comparing their results. The following rating scale was used in the interpretation of the importance:

Very Little Or None	Little	Below Average	Average	Important	Very Important
-----	-----	-----	-----	-----	-----
1+	2+	3+	4+	5+	6+

Research Question #4. Are there differences in how private sector facility managers and Air Force civil engineering officers rate these academic subjects? This research question was answered by conducting a t-test and a rank order correlation on the importance of the military and civilian respondents.

The t-test was used to check for a significant difference between means. A two sample t-test with the more conservative separate variance estimate was used. A separate variance estimate means that both population variances are not considered to be equal, and are therefore estimated by their respective sample variances. If, however, they were considered to be equal, then a single pooled variance estimator would result from the two sample variances. The separate variance estimate is a more conservative approach because the assumption that the two population variances are equal was not made (6:288).

In order to conduct this type of a "test of means," one assumption is necessary. Both populations require normality. A P-value was used to check against the chosen 95 percent level of statistical significance. A P-value smaller than 0.05 would lead to the rejection of the null hypothesis that the two means are equal, where a P-value larger than 0.05 would lead to the acceptance that the two means are equal (6:247,292).

The rank order correlation was conducted to find if a linear relationship exists between the two sets of ranks generated from the military and civilian respondents on the importance of the 59 academic subjects. The correlation gives an overall measure of how similarly the civilian and military respondents rated the academic subjects. Values from a rank order correlation can range between +1 to -1.



"Positive values indicate that 'high ranks tend to be associated with high ranks'; negative values indicate that 'high ranks on one variable tend to be associated with low ranks on the other'" (7:341). A rank order correlation of one would imply a perfect linear relationship between sample ranks of all 59 academic subjects, while a rank order correlation of zero would imply no correlation.

### Analyses

The statistical measures applied to the data were the means, standard deviations, and frequency histograms. Copies of the programs used to answer the research questions are listed in Appendix J. The programs consist of a program for the military respondents and the data, a program for the civilian respondents and the data, a t-test program, and a rank order correlation program. The rank order correlation program was written in SAS. All other programs were written in SPSSX.

## IV. Results

### Introduction

This chapter includes the description of the demographic characteristics of the respondents and an illustration of the results of the analysis on the survey data.

### Demographic Results

Two populations were surveyed, with a total of 315 surveys. Two hundred surveys were sent to the recipients of AIPE Facilities Management, Operations & Engineering, and 115 surveys were sent to Air Force GEM students who graduated within the last five years. Of the 200 surveys sent to the randomly sampled civilian facility managers, 65 (32.5 percent) were returned by the cutoff date. Of the 115 surveys sent to the civil engineering officers, 67 (58.3 percent) were returned by a given cutoff date. The military officers were given four weeks to respond, while the civilians had seven weeks to respond. Sample sizes of at least 41 civilians and 31 military were required to achieve the desired 90 percent confidence level that the samples were true representations of the populations. Since 65 civilians and 67 military responded, at least a 90 percent confidence level was achieved.

Table IV shows that over half the respondents are in middle management positions; 52.2 percent are military and

58.5 percent are civilians. More of the military (16.4 percent) than of the civilian (13.8 percent) respondents were in upper management positions. More of the civilian (16.9 percent) than of the military (7.5 percent) respondents were in supervisory positions. Engineering positions were represented equally by the military (10.4 percent) and the civilian (9.2 percent) respondents. More military (13.4 percent) did not respond to this question than the civilian (1.5 percent) respondents. Some military respondents did not feel that they fit in any of the categories provided in the survey so they wrote the following positions on the survey form: Staff Officer, Military Construction Program Manager, Site Civil Engineer, Faculty Instructor, Air Staff Officer, and Instructor.

TABLE IV  
RESPONSES BY POSITION

<u>Position</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
Upper Management	11	9	16.4	13.8
Middle Management	35	38	52.2	58.5
Supervisor	5	11	7.5	16.9
Engineer	7	6	10.4	9.2
Unspecified	9	1	13.4	1.5
TOTAL	67	65	100.0	100.0

Table V shows that the predominant rank of the military responding to the survey is captain (80.6 percent). Also, majors represented 16.4 percent of the respondents, and three percent of the respondents left this area blank. The

ranks indicate middle management positions, which correspond to the majority (52.2 percent) of the military claiming middle management positions from the previous table.

TABLE V  
RESPONSES BY RANK

<u>Rank</u>	<u>Frequency</u>	<u>Percent</u>
Lt. Colonel	0	0.0
Major	11	16.4
Captain	54	80.6
Lieutenant	0	0.0
Unspecified	<u>2</u>	<u>3.0</u>
TOTAL	67	100.0

Table VI shows that the majority of the civilians responding are employed by a manufacturing industry (66.2 percent). The non-manufacturing industry is represented by 30.8 percent of the respondents; 3.1 percent of the respondents left this area blank.

TABLE VI  
RESPONSES BY TYPE OF COMPANY

<u>Type Company</u>	<u>Frequency</u>	<u>Percent</u>
Manufacturing	43	66.2
Non-Manufacturing	20	30.8
Unspecified	<u>2</u>	<u>3.1</u>
TOTAL	65	100.0

Table VII shows the majority of the military respondents falling equally into the 0-6 year and the 7-10 year experience range (41.8 percent), while the civilians

are distributed throughout all categories with the highest frequency in the 7-10 year and 16-20 year experience range (18.5 percent). This indicates that the civilians have more experience than the military respondents.

TABLE VII  
RESPONSES BY EXPERIENCE

<u>Experience</u>	<u>Frequency</u>		<u>Percent</u>		<u>Cum %</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
0- 6 Years	28	9	41.8	13.8	41.8	13.8
7-10 Years	28	12	41.8	18.5	83.6	32.3
11-15 Years	8	9	11.9	13.8	95.5	46.2
16-20 Years	1	12	1.5	18.5	97.0	64.7
21-25 Years	0	10	0	15.4	97.0	80.1
26-30 Years	0	6	0	9.2	97.0	89.3
Over 30	0	6	0	9.2	97.0	98.5
Unspecified	<u>2</u>	<u>1</u>	<u>3.0</u>	<u>1.5</u>	100.0	100.0
TOTAL	67	65	100.0	100.0		

Table VIII shows that the majority of the civilian respondents to the survey had a Bachelor's degree (53.8 percent) and about a third had less than a Bachelor's degree (32.3 percent). It is not surprising that all the military had a Master's degree, since they were past graduates of the GEM program.

TABLE VIII  
RESPONSES BY EDUCATION

<u>Education</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
High School	0	7	0.0	10.8
Associate	0	14	0.0	21.5
Bachelor	0	35	0.0	53.8
Master	65	8	97.0	12.3
Doctorate	0	0	0.0	0.0
Unspecified	<u>2</u>	<u>1</u>	<u>3.0</u>	<u>1.5</u>
TOTAL	67	65	100.0	100.0

Table IX shows that most of the civilian respondents have undergraduate education in engineering (70.8 percent), rather than in management or other disciplines (12.4 percent). This confirms a recent study (A Profile of Plant Engineers & Facility Managers) published in 1987 by AIPE. Approximately 56 percent of the plant engineers possess a Bachelor's degree or greater, and of those who possess a Bachelor's degree, 70.5 percent have an engineering degree. This finding also supports the premise that private sector facility managers, who are responsible for the maintenance and repair of facilities, have backgrounds similar to the civil engineering officers. It was assumed that these private sector firms would draw upon personnel with a background similar to the civil engineering officer (Bachelor's degree in engineering), which is indeed the case shown here. Respondents (13.8 percent) who did not have an undergraduate education marked the not applicable response. Two respondents left this area blank.

TABLE IX

RESPONSES BY CIVILIAN UNDERGRADUATE EDUCATION

<u>Undergraduate Education</u>	<u>Frequency</u>	<u>Percent</u>
Engineering	46	70.8
Management	4	6.2
Other	4	6.2
Not Applicable	9	13.8
Unspecified	<u>2</u>	<u>3.1</u>
TOTAL	65	100.0

Table X shows that the majority of military and civilian responses are responsible for an annual operating budget of over \$1,000,000 (58.2 percent military, 60 percent civilian). The biggest disparity between the military and civilian samples is in the smallest budget range, from \$0-100,000. A quarter of the military sampled fell within this range, while only 6.2 percent for the civilians. A possible reason may be that base level jobs have responsibility over people instead of money.

TABLE X

RESPONSES BY BUDGET

<u>Budgets</u>	<u>Frequency</u>		<u>Percent</u>	
	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>
\$ 0-100K	17	4	25.4	6.2
\$100-500K	3	10	4.5	15.4
\$500K-1M	4	9	6.0	13.8
Over \$1M	39	39	58.2	60.0
Unspecified	<u>4</u>	<u>3</u>	<u>6.0</u>	<u>4.6</u>
TOTAL	67	65	100.0	100.0

### Research Question #1

The 59 academic subjects that facility managers may perceive as important are divided into six broad categories as shown previously at Table III.

### Research Question #2

Appendix G lists the mean responses to the three questions of (a) how much is applicable now, (b) how much should be applicable, and (c) the importance of the associated academic subject, as rated by the civilian and military respondents. By quick observation, it looks as if the mean ratings are close between the military and civilian responses for each question. This observation was suspect in some instances. Comments on three surveys said that there was not much differentiation between questions (a), (b), and (c), so these respondents generalized all three questions into one rating. A further investigation of the needs brings out this similarity in how the respondents answered the questions. The needs, which are discussed later in this section, showed only slight increases (less than one) in most academic subjects. This indicates that there were similar ratings of the (a) and (b) questions.

Table XI shows a pattern between the means of (a), (b), and (c). In each category the mean increases from (a) to (c). This suggests that there is an overall need for more application of academic subjects within all categories. The highest mean ratings of (a), (b), and (c) were on project



and qualitative categories, whereas the quantitative category received the lowest mean rating across the board. Financial, engineer/architect, and functional categories received average mean ratings. This result was not totally expected: the interviews suggested that the functional and qualitative categories would be rated higher than the other categories. While the qualitative category was rated important, the functional category was rated at only average importance.

TABLE XI  
RESPONSES TO THE THREE QUESTIONS BY CATEGORY

<u>Categories</u>	(a) How Much Do You Apply		(b) How Much Should You		(c) Importance	
	Civ	Mil	Civ	Mil	Civ	Mil
	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
Quantitative	2.691	2.218	3.265	2.697	3.402	3.109
Qualitative	4.152	4.429	4.723	4.940	4.968	5.310
Financial	4.051	3.217	4.639	3.713	4.906	4.167
Project	4.585	4.560	5.177	4.776	5.362	5.091
Engineer/Arch	4.012	3.069	4.563	3.538	4.809	4.114
Functional	3.844	3.507	4.394	3.887	4.664	4.361

Table XII lists the needs for academic subjects which were rated important by the military respondents. See Appendix H for a complete listing of academic subjects. A positive need indicates there is not enough of the skill now being applied. The need is calculated by subtracting (b) from (a). When (b) is greater than (a), there is a positive need. All but one need was positive, meaning there are not enough of these academic subjects now being applied. The

needs are not very distinctive; all but three [energy management (2.345), information systems (1.086), and interior design (1.079)] are less than one.

The civilian respondents had one negative need (building fire protection) and three needs greater than one (mentioned previously). The military respondents did not have any negative needs or needs greater than one, showing a good balance between what academic subjects were applicable in their job and what should be applied. Of the academic skills which the military rated important, the highest needs are in information systems, management principles, organizational theory, and communication.

Table XII

IMPORTANCE & NEED RATINGS OF ACADEMIC SUBJECTS  
(BY MILITARY RATING)

<u>Academic Subjects</u>	<u>Importance</u>		<u>Need</u>	
	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>
Professional Ethics	6.33	6.11	0.18	0.45
Public Speaking	6.18	5.27	0.44	0.60
Leadership	6.13	5.40	0.42	0.49
Management Principles	5.96	5.48	0.75	0.53
Personnel Management	5.86	5.83	0.47	0.49
Technical Writing	5.86	5.72	0.21	0.37
Communication	5.67	5.49	0.62	0.66
Construction Management	5.45	5.98	0.32	0.61
Behavioral Science	5.30	4.95	0.49	0.38
Project Management	5.28	5.84	0.13	0.58
Organizational Theory	5.23	4.81	0.52	0.79
Civil Engineering	5.22	4.06	0.27	0.48
Information Systems	5.08	4.25	0.83	1.08

Table XIII lists civilian and military needs by categories. The needs were higher in the qualitative and

financial categories for both military and civilian respondents. Even though the needs were shown to be greatest in these categories, the importance differs a little by showing the greatest ratings in the project and qualitative categories. The biggest disparity between the needs of the civilian and military was on the project category (0.391). The civilian respondents saw more need in the project area than did the military respondents, maybe because more problems exist in this area for the civilians than the military. Even though the project category is not rated highly by the military respondents, it does not imply it is not an important area. Rather, it only implies that the current amount of application is commensurate with how much should be applied.

TABLE XIII

NEED & IMPORTANCE BY CATEGORY

<u>Categories</u>	<u>Need</u>		<u>Importance</u>	
	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>
	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
Quantitative	.574	.410	3.402	3.109
Qualitative	.601	.529	4.968	5.310
Financial	.622	.526	4.906	4.167
Project	.585	.194	5.362	5.091
Engineer/Arch	.549	.480	4.809	4.114
Functional	.568	.398	4.664	4.361

Research Question #3

Table XII lists the academic subjects that the military rated important. A complete listing of all academic subjects and their ratings is at appendix H. The academic

subjects which are seen as very important (a mean of 6+) are professional ethics, public speaking, and leadership. There were ten academic subjects (17 percent) rated as important (a mean of 5+), 17 academic subjects (29 percent) rated as average importance (a mean of 4+), 23 academic subjects (41 percent) rated as below average importance (a mean of 3+), five academic subjects (seven percent) rated as little importance (a mean of 2+), and one academic subject (two percent) rated as very little or of no importance (a mean of 1+).

The most important single academic subject was professional ethics: it was rated the most important academic subject by both the military (6.33) and civilian (6.109) respondents. There was also a consensus on the three least important academic subjects. They were queuing theory (Mil 2.84, Civ 2.839), linear programming (Mil 2.14, Civ 2.345), and simulation modeling (Mil 1.65, Civ 1.925). This result was reconfirmed by the AFIT GEM survey assessment. In it, operations research, statistical concepts, scientific research, and accounting concepts were rated low. Operations research includes queuing theory and linear programming, which were rated of little importance. However, statistical analysis was rated as important and cost accounting was rated of average importance; these results were not expected. The civilian respondents ranked more academic subjects between the important (36 percent)

and average (34 percent) range, while the military respondents ranked more academic subjects between the average (29 percent) and below average (41 percent) range.

#### Research Question #4

Appendix I lists the T-values and P-values from the t-test analyses which were used to check for differences in the importance means of academic subjects between the two samples.

The civilian respondents rated 20 academic subjects (34 percent) significantly higher than did the military; as shown in Table XIV.

TABLE XIV

#### ACADEMIC SUBJECTS RATED SIGNIFICANTLY HIGHER BY CIVILIANS

Energy Management	Safety Engineering
Mechanical Engineering	Installation and Space Management
Energy Efficient Designs	Building Fire Protection
Value Engineering	Electrical Engineering
Facility Operations	Maintenance Management
Inventory Planning	Managerial Accounting
Cost Accounting	Industrial Engineering
Budget Preparation	Contract Policy
Engineering Economy	Forecasting
Computer Room Design	Construction Management

Therefore, these academic subjects are considered more important to the civilian respondents than to the military respondents.

The military respondents rated four academic subjects (seven percent) significantly higher than did the civilians. These were information systems, leadership, public speaking,

and civil engineering. A reason information systems may be of more concern to the military is because of the Work Information Management System (WIMS) initiative. WIMS minicomputer systems are being installed at Air Force Civil Engineering Squadrons throughout the world. Leadership is so ingrained with being a military officer and officership, it is of little wonder that this academic subject is rated higher by the military than by their civilian counterparts. Also, in the military there are more opportunities to speak publicly than there may be in the civilian environment. Finally, a reason civil engineering may be rated higher by the military than the civilian is the military title of civil engineering officer.

There were 35 academic subjects (59 percent) without a significant difference in means between the military and civilian respondents. This indicated that the civilian and military respondents rated these academic subjects of approximately equal importance.

A rank order correlation was used as an overall assessment of how closely the military and civilian respondents ranked the academic subjects. A correlation of 0.72 was obtained, which showed that there was a high correlation between how the military and civilian respondents ranked academic subjects by importance.

## V. Discussion and Conclusions

### Introduction

The purpose of this research was to investigate educational requirements of both military and civilian facility managers. The compiled list of academic subjects considered important by facility managers may help guide the GEM program to better fit the demand of facility managers. This chapter summarizes the results and makes recommendations based on the findings of this research.

### Demographics

Two populations were surveyed, civilians represented by recipients of the AIPE Facilities Management, Operations & Engineering magazine, and military officers, represented by past Air Force GEM students who graduated within the last five years. There were 67 officers and 65 civilians who responded to the survey. A census was conducted on the military, while a random sampling plan was applied to the civilian population. The civilian sample achieved the desired 90 percent confidence level, meaning that the sample statistics were representative of the original population.

Some of the demographics included the fact that over half of the respondents indicated that they had a background in engineering, were in the middle management position, and were responsible for budgets exceeding \$1,000,000. The predominant rank of the military responding to the survey

was captain. The majority of the civilians responding are employed by a manufacturing industry. The civilian respondents have more years of experience than do the military respondents, but have less formal education.

#### GEM Program

The present GEM program is 15 months in duration. Five quarters of classes and a short term are taught during that time. Appendix F lists the course titles taught and the credits associated with the class.

Previous Survey Results. Fiscal year 1985 GEM students rated operations research along with a couple of other quantitative courses low. The results of this survey reinforce the fiscal year 1985 GEM student rating by identifying two components of operations research as considered not very important to facility management (queuing theory and linear programming).

Improvement to Program. This survey lists some possible inclusions into the GEM program which may improve the overall program. Professional ethics was seen by both samples to be the most important academic subject in the survey. Also, 25 other academic subjects were rated important by the civilian or military respondents, and may have a potential for inclusion into existing GEM courses. Table XV lists the ratings and difference in means of the 26 academic subjects mentioned.



TABLE XV

ACADEMIC SUBJECTS RATED IMPORTANT  
BY EITHER MILITARY OR CIVILIAN RESPONDENTS

<u>Academic Subjects</u>	<u>Rating</u>	
	<u>Civ</u>	<u>Mil</u>
Professional Ethics	6+	6+
*Facility Operations	6+	4+
*Leadership	5+	6+
*Construction Management	5+	5+
Management Principles	5+	5+
Technical Writing	5+	5+
Communication	5+	5+
Statistical Analysis	5+	5+
Strategic Planning	5+	5+
*Public Speaking	5+	5+
*Maintenance Management	5+	4+
*Contract Policy	5+	4+
*Bldg Fire Protection	5+	4+
Life Cycle Costing	5+	4+
*Budget Preparation	5+	4+
Building Programming	5+	4+
Organizational Theory	4+	5+
Behavioral Science	4+	5+
*Civil Engineering	4+	5+
*Information Systems	4+	5+
*Energy Management	5+	3+
*Mechanical Engineering	5+	3+
*Safety Engineering	5+	3+
*Energy Efficient Design	5+	3+
*Install & Space Mgt	5+	3+
*Electrical Engineering	5+	3+
*Value Engineering	5+	3+

\* Academic subjects that were rated significantly different, as obtained from t-test results.

Very Little Or None	Little	Below Average	Average	Important	Very Important
1+	2+	3+	4+	5+	6+

Only one academic subject was rated very important by the military and civilian respondents (professional ethics). Eight academic subjects were rated important by the military and civilian respondents (construction management, management principles, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking). The military rated leadership and public speaking significantly higher than did the civilian respondents. The civilian respondents rated facility operations higher than did the military respondents. Six academic subjects were rated important by the civilian respondents and rated average importance by the military (maintenance management, contract policy, building fire protection, life cycle costing, budget preparation, and building programming). Of the six academic subjects, two had no significant difference between means (building programming and life cycle costing). The rest (maintenance management, contract policy, building fire protection, and budget preparation) had a significant difference between the means, with the civilian respondents rating these academic subjects higher than did the military respondents. Four academic subjects were rated important by the military respondents and average importance by the civilian respondents (organizational theory, behavioral science, civil engineering, and information systems). Of these four academic subjects, two (organizational theory and behavioral

science) had no significant differences between the means of the military and civilian respondents. The other two (civil engineering and information systems) were rated higher by the military respondents than the civilian respondents. Seven academic subjects were rated important by the civilian respondents and rated below average in importance by the military respondents (energy management, mechanical engineering, safety engineering, energy efficient design, installation and space management, electrical engineering, and value engineering). All seven academic subjects were rated significantly higher by the civilian respondents than the military respondents.

Existing GEM Subjects. The academic subjects rated important by either the military or civilian respondents which the GEM program includes are:

Life Cycle Costing	Organizational Theory
Leadership	Management Principles
Contract Policy	Information Systems
Technical Writing	Energy Management
Communication	Strategic Planning
Statistical Analysis	Installation & Space Mgt
Public Speaking	Energy Efficient Designs

Potential GEM Inclusions. The academic subjects which are not included in the GEM program, but were rated important by either the civilian or military respondents:

Professional Ethics	Facility Operations
Construction Management	Building Fire Protection
Maintenance Management	Building Programming
Budget Preparation	Safety Engineering
Civil Engineering	Value Engineering
Mechanical Engineering	Electrical Engineering

Inclusion of these academic subjects may be achieved by allowing more electives into the GEM course.

### Summary

In summary, a list of academic subjects was analyzed as to their importance in facilities management. The academic subjects were rated by military and private sector civilian facility managers. Ratings were given as to (a) how much is applicable now, (b) how much should be applicable, and (c) the importance. The need was determined by subtracting a from b ( $b - a$ ). Differences in rating between the two populations were determined by t-tests and a rank order correlation.

The overall objective was to methodically and logically report and analyze academic subjects that may improve the GEM program. Professional ethics was seen by both populations to merit the most importance. Some of the popularity of this academic subject may stem from the recent publicity of Lt. Col. North and the Contra Arms Sales. Realizing the compressed 15-month scheduling of classes of the GEM program, it would be almost impossible to add courses into the already jammed course load. However, a shift of emphasis on some of the most important academic subjects included in Table XV may improve the scope of study.

Further research into this area is required. Only 59 academic subjects were addressed; many more may be of

potential interest. Also, only past GEM graduates were surveyed; more information may be gathered from civil engineering officers at base level. An area that was not addressed was how other government agencies educate their facility managers. It would have been interesting to include other services such as the Army and Navy engineers or facility engineers in charge of cities, colleges, or hospitals to see what their responses would have been.

Appendix A: Information Request Letter

20 January 1987

Gentlemen:

I am Captain David M. Kreag, an Air Force Institute of Technology student in Engineering Management at Wright Patterson AFB, Ohio. I am doing a thesis on how the private sector educates their facility managers (i.e., someone who is involved in overseeing the maintenance, repair, design, development, and construction of facilities) in comparison to how the Air Force conducts its program. The goal of my thesis is to improve the content of the Graduate Engineering Management program. What I want to focus on is subject matter: knowledge, subjects, and abilities that the facility engineer needs to do his/her job. I am also interested in certification qualifications or courses being taught either through colleges, universities, or by seminar. You can help me by providing a personal and/or a company list of subjects, course descriptions deemed important for facility managers, or anything else you think might be helpful. If you have any suggestions on publications to look at or people to contact to gain knowledge in this area, please let me know. I will appreciate any cooperation or suggestions you can give.

If you have anything you would like to share, please send it to the following address:

David M. Kreag  
2361 Duncan Drive, Apt. #6  
Fairborn, Ohio 45324

My phone number is (513) 429-4583; however with classes the best time to reach me is after 4 p.m. Thank you for your time.

Sincerely,

David M. Kreag

### Appendix B: Organizations Contacted

Engineering Professional Development  
University of Wisconsin  
Madison, Wisconsin

TRW Operations & Support Group  
Redondo Beach, California

California Polytechnic State University  
San Luis Obispo, California

The Association of  
Physical Plant Administrators of  
Universities and Colleges  
Alexandria, Virginia

XIT Grounding Systems  
Torrance, California

Facilities Engineering  
US Army Engineer School  
Fort Belvoir, Virginia

American Society for Engineering Management  
Lowell, Massachusetts

National Society of Professional Engineers  
Alexandria, Virginia

University of Missouri  
Department of Engineering Management  
Rolla, Missouri

Bell Communications Research  
Lisle, Illinois

American Institute of Plant Engineers  
Cincinnati, Ohio

Appendix C: Survey Package for Civilian Sample



American Institute of Plant Engineers  
3975 Erie Ave. • Cincinnati, Ohio 45208 • (513) 561-6000

27 April 1987

You have been selected at random to participate in a study on educational requirements for facility and plant engineers. It will take about 20-30 minutes of your time. Response is voluntary and private, but we would greatly appreciate your input.

The hypothesis is that there is a common core of educational skills that facility and plant engineers see as important. The American Institute of Plant Engineers in conjunction with the Air Force Institute of Technology is conducting this research to influence college programs to better fit the needs of industry.

Your response will be held in strict confidentiality. The questionnaire has an identification number for mailing purposes only. Your name will not be put on your questionnaire.

In order to help shape the education of future facility and plant engineers, it is important that each questionnaire be completed and returned by May 31, 1987. Thank you for your assistance.

Sincerely,

A handwritten signature in cursive script that reads "Tom Klug".

Tom Klug  
Director of Association Development

Education and Research Arm of the American Institute of Plant Engineers



## SECTION I. NEED ASSESSMENT

On the following pages will be listed several educational subjects connected with your own management position. For each subject, you will be asked to give three ratings.

- a) How much of the subject are you able to apply in connection with your management position?
- b) How much of the subject do you think should be applicable in connection with your management position?
- c) How important is this subject to you?

Each rating will be on a seven-point scale.

(minimum)    1    2    3    4    5    6    7    (maximum)

Please completely fill in the circle (using a #2 pencil) that represents the amount of the subject being rated on the computer scan sheet enclosed with the survey form. Low numbers represent low or minimum amounts, and high numbers represent high or maximum amounts. If you think there is "very little" or "none" of the subject presently associated with the position, you would choose numeral 1. If you think there is "just a little," you would choose numeral 2, and so on. If you think there is a "great deal but not a maximum amount," you would choose numeral 5. If you think the subject does not apply to you, choose the circle with NA to the left of the corresponding question on the computer scan sheet.

For each subject, choose only one number.

Please do not omit any subjects.

## QUANTITATIVE

(minimum)    1   2   3   4   5   6   7    (maximum)

## Linear Programming Concepts (Including Goal Programming, Integer Programming, & Sensitivity Analysis)

- 001) How much are you able to apply now?  
002) How much should be applicable to your position?  
003) How important is this to you?

**Network Modeling (Including Program Evaluation Review Technique (PERT), and Critical Path Method (CPM))**

- 004) How much are you able to apply now?  
005) How much should be applicable to your position?  
006) How important is this to you?

Simulation Modeling (Such as SLAM, SIMSCRIPT, etc.)

- 007) How much are you able to apply now?
- 008) How much should be applicable to your position?
- 009) How important is this to you?

Decision Theory (Including Risk & Uncertainty Analysis, Problem Solving Techniques, and Methods to Evaluate Alternatives)

- 010) How much are you able to apply now?
- 011) How much should be applicable to your position?
- 012) How important is this to you?

Forecasting (Including Seasonal Adjustments, Annual & Monthly Data Analysis, and Translating Market Factors into the Forecast)

- 013) How much are you able to apply now?
- 014) How much should be applicable to your position?
- 015) How important is this to you?

Queuing Theory (Such as System Modeling, Waiting Line Analysis, and Bottleneck Problems)

- 016) How much are you able to apply now?
- 017) How much should be applicable to your position?
- 018) How important is this to you?

Inventory Planning (Such as Economic Order Quantity Model, Material Requirements Planning Model, and Just-in-Time Inventory Control)

- 019) How much are you able to apply now?
- 020) How much should be applicable to your position?
- 021) How important is this to you?

Statistical Analysis (Including Probability Distributions, Hypothesis Testing, Interval Estimation, Analysis of Variance, and Regression & Correlation)

- 022) How much are you able to apply now?
- 023) How much should be applicable to your position?
- 024) How important is this to you?

QUALITATIVE

(minimum) 1 2 3 4 5 6 7 (maximum)

General Management Principles (Such as Consideration of Manager's Types, Subjects, and Roles; and Methods to Increase Productivity Through Management)

025) How much are you able to apply now?

026) How much should be applicable to your position?

027) How important is this to you?

Organizational Theory (Including Organizational Designs, Control, Functions, and Socialization)

028) How much are you able to apply now?

029) How much should be applicable to your position?

030) How important is this to you?

Behavioral Science (Such as Industrial Psychology, Motivation Theory, etc.)

031) How much are you able to apply now?

032) How much should be applicable to your position?

033) How important is this to you?

Strategic Planning (Including Strategic Issues, Evaluating the Competitive Analyst's Report, Implementing Competitive Strategy, and Advertising Considerations)

034) How much are you able to apply now?

035) How much should be applicable to your position?

036) How important is this to you?

Leadership (Including Leadership Theories, Factors Influencing Leadership Effectiveness, and Cultural Differences in Leadership)

037) How much are you able to apply now?

038) How much should be applicable to your position?

039) How important is this to you?

Personnel Management (Including Performance Appraisal, Job Analysis, Training & Development, and Employee Selection)

040) How much are you able to apply now?

041) How much should be applicable to your position?

042) How important is this to you?

Master Planning (Including Planning Process, Sources & Organization of Planning Data, and Teamwork Concept to Prepare a Master Plan)

- 043) How much are you able to apply now?
- 044) How much should be applicable to your position?
- 045) How important is this to you?

FINANCIAL (minimum) 1 2 3 4 5 6 7 (maximum)

Managerial Accounting (Including Cost Concepts, Managerial Applications and Limitations of Cost Data in Planning & Control)

- 046) How much are you able to apply now?
- 047) How much should be applicable to your position?
- 048) How important is this to you?

Cost Accounting (Including Labor Cost Analysis, Distribution of Overhead, and Depreciation Methods)

- 049) How much are you able to apply now?
- 050) How much should be applicable to your position?
- 051) How important is this to you?

Engineering Economy (Including Capital Budgeting, Net Present Value Analysis, and Compound Interest Formulas)

- 052) How much are you able to apply now?
- 053) How much should be applicable to your position?
- 054) How important is this to you?

Financial Management (Including Financial Statements, Comparative Analysis, Cost/Volume Analysis, and Cash Flow & Working Capital Analysis)

- 055) How much are you able to apply now?
- 056) How much should be applicable to your position?
- 057) How important is this to you?

Budget Preparation (Including Budgeting for Capital Improvements, Financial Components & Concepts, and Budget Manager's Function)

- 058) How much are you able to apply now?
- 059) How much should be applicable to your position?
- 060) How important is this to you?

Building Programming (Including Building Planning Process,  
Site Evaluation, Total Space Requirements, and Total  
Building Energy & Control Systems)

- 061) How much are you able to apply now?
- 062) How much should be applicable to your position?
- 063) How important is this to you?

Life Cycle Costing (Including Economic Analysis, Reliability  
& Maintainability, Cost Estimating Techniques, and  
Procurement)

- 064) How much are you able to apply now?
- 065) How much should be applicable to your position?
- 066) How important is this to you?

PROJECT (minimum) 1 2 3 4 5 6 7 (maximum)

Project Management (Including Project Scheduling, Strategies  
for On-Time Project Completion, Developing Contingency  
Plans, Project Close-Out Activities)

- 067) How much are you able to apply now?
  - 068) How much should be applicable to your position?
  - 069) How important is this to you?
- Group Projects (Group Dynamics & Interaction)

- 070) How much are you able to apply now?
- 071) How much should be applicable to your position?
- 072) How important is this to you?

ENGINEERING/ARCHITECTURE (minimum) 1 2 3 4 5 6 7 (maximum)

Civil Engineering

- 073) How much are you able to apply now?
- 074) How much should be applicable to your position?
- 075) How important is this to you?

Mechanical Engineering

- 076) How much are you able to apply now?
- 077) How much should be applicable to your position?
- 078) How important is this to you?

Electrical Engineering

- 079) How much are you able to apply now?
- 080) How much should be applicable to your position?
- 081) How important is this to you?

Industrial Engineering (Including Quality Control Techniques, Productivity Measurements, and Time and Motion Studies)

- 082) How much are you able to apply now?
- 083) How much should be applicable to your position?
- 084) How important is this to you?

Architectural Design

- 085) How much are you able to apply now?
- 086) How much should be applicable to your position?
- 087) How important is this to you?

Interior Design (Including Mechanical Considerations, Electrical Considerations, and Interior Construction)

- 088) How much are you able to apply now?
- 089) How much should be applicable to your position?
- 090) How important is this to you?

Computer Systems Design (Including Computer Design, System Hardware & Software, and System Control)

- 091) How much are you able to apply now?
- 092) How much should be applicable to your position?
- 093) How important is this to you?

Safety Engineering (Including OSHA Requirements, Evaluating Alternative Safety Features, and Implementation of Safety Features in Design & Existing Equipment)

- 094) How much are you able to apply now?
- 095) How much should be applicable to your position?
- 096) How important is this to you?

Value Engineering (Including Negotiating, Servicing, Approving, Administering, and Evaluating the Contractual Value Engineering Effort of Contractors)

- 097) How much are you able to apply now?
- 098) How much should be applicable to your position?
- 099) How important is this to you?

Energy Efficient Designs (Including Evaluation Techniques of Energy Efficient Designs)

- 100) How much are you able to apply now?
- 101) How much should be applicable to your position?
- 102) How important is this to you?

FUNCTIONAL

(minimum) 1 2 3 4 5 6 7 (maximum)

Computer Science (Including Historical Development, Parts of a Computer, Functions of a Computer and Computer Programming)

- 103) How much are you able to apply now?
- 104) How much should be applicable to your position?
- 105) How important is this to you?

Information Systems (Including Management Information System, and Decision Support System)

- 106) How much are you able to apply now?
- 107) How much should be applicable to your position?
- 108) How important is this to you?

Computer Aided Design / Computer Aided Manufacturing

- 109) How much are you able to apply now?
- 110) How much should be applicable to your position?
- 111) How important is this to you?

Computer Room Design (Including Flooring, Air Conditioning, Equipment Selection, Grounding, and Line Conditioning)

- 112) How much are you able to apply now?
- 113) How much should be applicable to your position?
- 114) How important is this to you?

Communication (Including Interviewing Techniques, Panel Discussions, Meeting Management, and Conflict Resolution)

- 115) How much are you able to apply now?
- 116) How much should be applicable to your position?
- 117) How important is this to you?

Public Speaking (Including Delivery Techniques, Audio/Visual Use, and Handling the Questions and Answers)

- 118) How much are you able to apply now?
- 119) How much should be applicable to your position?
- 120) How important is this to you?

Technical Writing (Including Grammar, Syntax, Mechanics, and Style & Format)

- 121) How much are you able to apply now?
- 122) How much should be applicable to your position?
- 123) How important is this to you?

Business Law (Such as Crimes, Torts, Frauds, Employment Law, and Partnerships & Corporations)

- 124) How much are you able to apply now?
- 125) How much should be applicable to your position?
- 126) How important is this to you?

Marketing (Including Preliminary Analysis, Listening to Customers, Marketing Philosophy & Strategy, and Advertising & Promotion)

- 127) How much are you able to apply now?
- 128) How much should be applicable to your position?
- 129) How important is this to you?

Quality Control (Such as Statistical Quality Control, Quality Assurance, and Material Handling)

- 130) How much are you able to apply now?
- 131) How much should be applicable to your position?
- 132) How important is this to you?

Research & Design Management (Such as Management Techniques in a Research & Design Environment, and Scheduling Techniques)

- 133) How much are you able to apply now?
- 134) How much should be applicable to your position?
- 135) How important is this to you?

Innovation Techniques (Such as Brain Storming, Nominal Group Technique, and the Delphi Method)

- 136) How much are you able to apply now?
- 137) How much should be applicable to your position?
- 138) How important is this to you?

Entrepreneurship (Including Market Evaluation, Business Law, Evaluating Alternatives, and Franchising)

- 139) How much are you able to apply now?
- 140) How much should be applicable to your position?
- 141) How important is this to you?

Professional Ethics

- 142) How much are you able to apply now?
- 143) How much should be applicable to your position?
- 144) How important is this to you?



Labor Relations (Such as Landmark Judicial Decisions,  
Current Trends, and Formalized Labor Relations)

- 145) How much are you able to apply now?
- 146) How much should be applicable to your position?
- 147) How important is this to you?

Collective Bargaining (Including Grievance Situations and  
Dispute Settlements)

- 148) How much are you able to apply now?
- 149) How much should be applicable to your position?
- 150) How important is this to you?

Public Policy (Including How Government Policy Affects the  
General Movement of the Economy)

- 151) How much are you able to apply now?
- 152) How much should be applicable to your position?
- 153) How important is this to you?

Contract Policy (Including the Bid Process; Contract  
Discrepancies; Specification Writing; and Responsibilities  
of the Owner, Architect, and Contractor)

- 154) How much are you able to apply now?
- 155) How much should be applicable to your position?
- 156) How important is this to you?

Building Fire Protection (Including Fire Prevention,  
Protection, and Safety Administration)

- 157) How much are you able to apply now?
- 158) How much should be applicable to your position?
- 159) How important is this to you?

Real Estate Acquisition & Disposal (Including Appraisal  
Analysis, and Real Estate Laws)

- 160) How much are you able to apply now?
- 161) How much should be applicable to your position?
- 162) How important is this to you?

Installation & Space Management (Including Plant Layout and  
Design, and System Flow Analysis)

- 163) How much are you able to apply now?
- 164) How much should be applicable to your position?
- 165) How important is this to you?

Construction Management (Including Building Inspections, and Interpretation and Use of Drawings & Specifications)

- 166) How much are you able to apply now?
- 167) How much should be applicable to your position?
- 168) How important is this to you?

Maintenance Management (Including Preventative Maintenance Schedules, and Evaluating Techniques)

- 169) How much are you able to apply now?
- 170) How much should be applicable to your position?
- 171) How important is this to you?

Facility Operations (Including Design Parameters, Building Maintenance, Preventative Maintenance, and Fire & Safety Considerations)

- 172) How much are you able to apply now?
- 173) How much should be applicable to your position?
- 174) How important is this to you?

Energy Management (Including Energy Conservation Techniques, and Evaluating Alternatives)

- 175) How much are you able to apply now?
- 176) How much should be applicable to your position?
- 177) How important is this to you?

SECTION II. DEMOGRAPHICS

178. My position level is \_\_\_\_\_.

- 1) Upper Management
- 2) Middle Management
- 3) First Level Manager/Supervisor
- 4) Engineer
- 5) Other \_\_\_\_\_ (Please specify.)

179. The company I work for does \_\_\_\_\_.

- 1) Manufacturing
- 2) Non-Manufacturing

180. My years of experience in facility maintenance and plant engineering is \_\_\_\_\_.

- 1) 0- 6 years
- 2) 7-10 years
- 3) 11-15 years
- 4) 16-20 years
- 5) 21-25 years
- 6) 26-30 years
- 7) Over 30

181. My highest level of formal education achieved is

- 1) High School Diploma or Equivalent
- 2) Associate's Degree
- 3) Bachelor's Degree
- 4) Master's Degree
- 5) Doctorate

182. My undergraduate education is in \_\_\_\_\_.

- 1) Engineering/Technology
- 2) Management
- 3) Other \_\_\_\_\_ (Please specify.)
- 4) Not Applicable (No Bachelor's Degree)

183. The annual operating budget for which I am responsible is \$ \_\_\_\_\_.

- 1) \$ 0 - 100,000
- 2) \$ 100,001 - 500,000
- 3) \$ 500,001 - 1,000,000
- 4) \$ 1,000,001 - 5,000,000
- 5) \$ 5,000,001 - 10,000,000
- 6) \$ 10,000,001 - 15,000,000
- 7) \$ over 15,000,000

Appendix D: Survey Package for Military Sample

LS (Capt Kreag, AUTOVON 785-5435)

Educational Need Assessment Survey Package

1. Please take the time to complete the attached questionnaire and return it to us in the enclosed envelope by 15 June 1987.
2. The survey measures your perceptions and attitudes toward academic subjects that contribute to your job. The data we gather will become part of the Air Force Institute of Technology research project and may influence the courses taught in the Graduate Engineering Management program. Your individual responses will be combined with others and will not be attributed to you personally.
3. Your participation is completely voluntary, but we would certainly appreciate your help. For further information, contact Maj. Hal Rumsey at AUTOVON 785-5023.

HAL A. RUMSEY, Maj, USAF  
GEM Program Director

- 2 Atch
1. Questionnaire
  2. Return Envelope

## SECTION I. NEED ASSESSMENT

On the following pages will be listed several educational subjects connected with your own management position. For each subject, you will be asked to give three ratings.

- a) How much of the subject are you able to apply in connection with your management position?
- b) How much of the subject do you think should be applicable in connection with your management position?
- c) How important is this subject to you?

Each rating will be on a seven-point scale.

(minimum)    1   2   3   4   5   6   7    (maximum)

Please completely fill in the circle (using a #2 pencil) that represents the amount of the subject being rated on the computer scan sheet enclosed with the survey form. Low numbers represent low or minimum amounts, and high numbers represent high or maximum amounts. If you think there is "very little" or "none" of the subject presently associated with the position, you would choose numeral 1. If you think there is "just a little," you would choose numeral 2, and so on. If you think there is a "great deal but not a maximum amount," you would choose numeral 6. If you think the subject does not apply to you, choose the circle with NA to the left of the corresponding question on the computer scan sheet.

For each subject, choose only one number.

Please do not omit any subjects.

QUANTITATIVE                      (minimum)    1   2   3   4   5   6   7    (maximum)

Linear Programming Concepts (Including Goal Programming, Integer Programming, & Sensitivity Analysis)

- 001) How much are you able to apply now?
- 002) How much should be applicable to your position?
- 003) How important is this to you?

Network Modeling (Including Program Evaluation Review Technique (PERT), and Critical Path Method (CPM))

- 004) How much are you able to apply now?
- 005) How much should be applicable to your position?
- 006) How important is this to you?

Simulation Modeling (Such as SLAM, SIMSCRIPT, etc.)

- 007) How much are you able to apply now?
- 008) How much should be applicable to your position?
- 009) How important is this to you?

Decision Theory (Including Risk & Uncertainty Analysis, Problem Solving Techniques, and Methods to Evaluate Alternatives)

- 010) How much are you able to apply now?
- 011) How much should be applicable to your position?
- 012) How important is this to you?

Forecasting (Including Seasonal Adjustments, Annual & Monthly Data Analysis, and Translating Market Factors into the Forecast)

- 013) How much are you able to apply now?
- 014) How much should be applicable to your position?
- 015) How important is this to you?

Queuing Theory (Such as System Modeling, Waiting Line Analysis, and Bottleneck Problems)

- 016) How much are you able to apply now?
- 017) How much should be applicable to your position?
- 018) How important is this to you?

Inventory Planning (Such as Economic Order Quantity Model, Material Requirements Planning Model, and Just-in-Time Inventory Control)

- 019) How much are you able to apply now?
- 020) How much should be applicable to your position?
- 021) How important is this to you?

Statistical Analysis (Including Probability Distributions, Hypothesis Testing, Interval Estimation, Analysis of Variance, and Regression & Correlation)

- 022) How much are you able to apply now?
- 023) How much should be applicable to your position?
- 024) How important is this to you?

QUALITATIVE (minimum) 1 2 3 4 5 6 7 (maximum)

General Management Principles (Such as Consideration of Manager's Types, Subjects, and Roles; and Methods to Increase Productivity Through Management)

025) How much are you able to apply now?

026) How much should be applicable to your position?

027) How important is this to you?

Organizational Theory (Including Organizational Designs, Control, Functions, and Socialization)

028) How much are you able to apply now?

029) How much should be applicable to your position?

030) How important is this to you?

Behavioral Science (Such as Industrial Psychology, Motivation Theory, etc.)

031) How much are you able to apply now?

032) How much should be applicable to your position?

033) How important is this to you?

Strategic Planning (Including Strategic Issues, Evaluating the Competitive Analyst's Report, Implementing Competitive Strategy, and Advertising Considerations)

034) How much are you able to apply now?

035) How much should be applicable to your position?

036) How important is this to you?

Leadership (Including Leadership Theories, Factors Influencing Leadership Effectiveness, and Cultural Differences in Leadership)

037) How much are you able to apply now?

038) How much should be applicable to your position?

039) How important is this to you?

Personnel Management (Including Performance Appraisal, Job Analysis, Training & Development, and Employee Selection)

040) How much are you able to apply now?

041) How much should be applicable to your position?

042) How important is this to you?

Master Planning (Including Planning Process, Sources & Organization of Planning Data, and Teamwork Concept to Prepare a Master Plan)

- 043) How much are you able to apply now?
- 044) How much should be applicable to your position?
- 045) How important is this to you?

FINANCIAL (minimum) 1 2 3 4 5 6 7 (maximum)

Managerial Accounting (Including Cost Concepts, Managerial Applications and Limitations of Cost Data in Planning & Control)

- 046) How much are you able to apply now?
- 047) How much should be applicable to your position?
- 048) How important is this to you?

Cost Accounting (Including Labor Cost Analysis, Distribution of Overhead, and Depreciation Methods)

- 049) How much are you able to apply now?
- 050) How much should be applicable to your position?
- 051) How important is this to you?

Engineering Economy (Including Capital Budgeting, Net Present Value Analysis, and Compound Interest Formulas)

- 052) How much are you able to apply now?
- 053) How much should be applicable to your position?
- 054) How important is this to you?

Financial Management (Including Financial Statements, Comparative Analysis, Cost/Volume Analysis, and Cash Flow & Working Capital Analysis)

- 055) How much are you able to apply now?
- 056) How much should be applicable to your position?
- 057) How important is this to you?

Budget Preparation (Including Budgeting for Capital Improvements, Financial Components & Concepts, and Budget Manager's Function)

- 058) How much are you able to apply now?
- 059) How much should be applicable to your position?
- 060) How important is this to you?



Building Programming (Including Building Planning Process,  
Site Evaluation, Total Space Requirements, and Total  
Building Energy & Control Systems)

- 061) How much are you able to apply now?
- 062) How much should be applicable to your position?
- 063) How important is this to you?

Life Cycle Costing (Including Economic Analysis, Reliability  
& Maintainability, Cost Estimating Techniques, and  
Procurement)

- 064) How much are you able to apply now?
- 065) How much should be applicable to your position?
- 066) How important is this to you?

PROJECT (minimum) 1 2 3 4 5 6 7 (maximum)

Project Management (Including Project Scheduling, Strategies  
for On-Time Project Completion, Developing Contingency  
Plans, Project Close-Out Activities)

- 067) How much are you able to apply now?
- 068) How much should be applicable to your position?
- 069) How important is this to you?

Group Projects (Group Dynamics & Interaction)

- 070) How much are you able to apply now?
- 071) How much should be applicable to your position?
- 072) How important is this to you?

ENGINEERING/ARCHITECTURE minimum) 1 2 3 4 5 6 7 (maximum)

Civil Engineering

- 073) How much are you able to apply now?
- 074) How much should be applicable to your position?
- 075) How important is this to you?

Mechanical Engineering

- 076) How much are you able to apply now?
- 077) How much should be applicable to your position?
- 078) How important is this to you?

Electrical Engineering

- 079) How much are you able to apply now?
- 080) How much should be applicable to your position?
- 081) How important is this to you?

Industrial Engineering (Including Quality Control Techniques, Productivity Measurements, and Time and Motion Studies)

- 082) How much are you able to apply now?
- 083) How much should be applicable to your position?
- 084) How important is this to you?

Architectural Design

- 085) How much are you able to apply now?
- 086) How much should be applicable to your position?
- 087) How important is this to you?

Interior Design (Including Mechanical Considerations, Electrical Considerations, and Interior Construction)

- 088) How much are you able to apply now?
- 089) How much should be applicable to your position?
- 090) How important is this to you?

Computer Systems Design (Including Computer Design, System Hardware & Software, and System Control)

- 091) How much are you able to apply now?
- 092) How much should be applicable to your position?
- 093) How important is this to you?

Safety Engineering (Including OSHA Requirements, Evaluating Alternative Safety Features, and Implementation of Safety Features in Design & Existing Equipment)

- 094) How much are you able to apply now?
- 095) How much should be applicable to your position?
- 096) How important is this to you?

Value Engineering (Including Negotiating, Servicing, Approving, Administering, and Evaluating the Contractual Value Engineering Effort of Contractors)

- 097) How much are you able to apply now?
- 098) How much should be applicable to your position?
- 099) How important is this to you?

Energy Efficient Designs (Including Evaluation Techniques of Energy Efficient Designs)

- 100) How much are you able to apply now?
- 101) How much should be applicable to your position?
- 102) How important is this to you?

FUNCTIONAL

(minimum) 1 2 3 4 5 6 7 (maximum)

Computer Science (Including Historical Development, Parts of a Computer, Functions of a Computer and Computer Programming)

- 103) How much are you able to apply now?
- 104) How much should be applicable to your position?
- 105) How important is this to you?

Information Systems (Including Management Information System, and Decision Support System)

- 106) How much are you able to apply now?
- 107) How much should be applicable to your position?
- 108) How important is this to you?

Computer Aided Design / Computer Aided Manufacturing

- 109) How much are you able to apply now?
- 110) How much should be applicable to your position?
- 111) How important is this to you?

Computer Room Design (Including Flooring, Air Conditioning, Equipment Selection, Grounding, and Line Conditioning)

- 112) How much are you able to apply now?
- 113) How much should be applicable to your position?
- 114) How important is this to you?

Communication (Including Interviewing Techniques, Panel Discussions, Meeting Management, and Conflict Resolution)

- 115) How much are you able to apply now?
- 116) How much should be applicable to your position?
- 117) How important is this to you?

Public Speaking (Including Delivery Techniques, Audio/Visual Use, and Handling the Questions and Answers)

- 118) How much are you able to apply now?
- 119) How much should be applicable to your position?
- 120) How important is this to you?

Technical Writing (Including Grammar, Syntax, Mechanics, and Style & Format)

- 121) How much are you able to apply now?
- 122) How much should be applicable to your position?
- 123) How important is this to you?

Business Law (Such as Crimes, Torts, Frauds, Employment Law, and Partnerships & Corporations)

- 124) How much are you able to apply now?
- 125) How much should be applicable to your position?
- 126) How important is this to you?

Marketing (Including Preliminary Analysis, Listening to Customers, Marketing Philosophy & Strategy, and Advertising & Promotion)

- 127) How much are you able to apply now?
- 128) How much should be applicable to your position?
- 129) How important is this to you?

Quality Control (Such as Statistical Quality Control, Quality Assurance, and Material Handling)

- 130) How much are you able to apply now?
- 131) How much should be applicable to your position?
- 132) How important is this to you?

Research & Design Management (Such as Management Techniques in a Research & Design Environment, and Scheduling Techniques)

- 133) How much are you able to apply now?
- 134) How much should be applicable to your position?
- 135) How important is this to you?

Innovation Techniques (Such as Brain Storming, Nominal Group Technique, and the Delphi Method)

- 136) How much are you able to apply now?
- 137) How much should be applicable to your position?
- 138) How important is this to you?

Entrepreneurship (Including Market Evaluation, Business Law, Evaluating Alternatives, and Franchising)

- 139) How much are you able to apply now?
- 140) How much should be applicable to your position?
- 141) How important is this to you?

Professional Ethics

- 142) How much are you able to apply now?
- 143) How much should be applicable to your position?
- 144) How important is this to you?

Labor Relations (Such as Landmark Judicial Decisions,  
Current Trends, and Formalized Labor Relations)

- 145) How much are you able to apply now?
- 146) How much should be applicable to your position?
- 147) How important is this to you?

Collective Bargaining (Including Grievance Situations and  
Dispute Settlements)

- 148) How much are you able to apply now?
- 149) How much should be applicable to your position?
- 150) How important is this to you?

Public Policy (Including How Government Policy Affects the  
General Movement of the Economy)

- 151) How much are you able to apply now?
- 152) How much should be applicable to your position?
- 153) How important is this to you?

Contract Policy (Including the Bid Process; Contract  
Discrepancies; Specification Writing; and Responsibilities  
of the Owner, Architect, and Contractor)

- 154) How much are you able to apply now?
- 155) How much should be applicable to your position?
- 156) How important is this to you?

Building Fire Protection (Including Fire Prevention,  
Protection, and Safety Administration)

- 157) How much are you able to apply now?
- 158) How much should be applicable to your position?
- 159) How important is this to you?

Real Estate Acquisition & Disposal (Including Appraisal  
Analysis, and Real Estate Laws)

- 160) How much are you able to apply now?
- 161) How much should be applicable to your position?
- 162) How important is this to you?

Installation & Space Management (Including Plant Layout and  
Design, and System Flow Analysis)

- 163) How much are you able to apply now?
- 164) How much should be applicable to your position?
- 165) How important is this to you?

Construction Management (Including Building Inspections, and Interpretation and Use of Drawings & Specifications)

- 166) How much are you able to apply now?
- 167) How much should be applicable to your position?
- 168) How important is this to you?

Maintenance Management (Including Preventative Maintenance Schedules, and Evaluating Techniques)

- 169) How much are you able to apply now?
- 170) How much should be applicable to your position?
- 171) How important is this to you?

Facility Operations (Including Design Parameters, Building Maintenance, Preventative Maintenance, and Fire & Safety Considerations)

- 172) How much are you able to apply now?
- 173) How much should be applicable to your position?
- 174) How important is this to you?

Energy Management (Including Energy Conservation Techniques, and Evaluating Alternatives)

- 175) How much are you able to apply now?
- 176) How much should be applicable to your position?
- 177) How important is this to you?

SECTION II. DEMOGRAPHICS

178. My position level is \_\_\_\_\_.

- 1) Upper Management
- 2) Middle Management
- 3) First Level Manager/Supervisor
- 4) Engineer
- 5) Other \_\_\_\_\_ (Please specify.)

179. My rank is \_\_\_\_\_.

- 1) Lieutenant
- 2) Captain
- 3) Major
- 4) Lt Colonel

180. My years of experience in civil engineering is \_\_\_\_\_.

- 1) 0- 6 years
- 2) 7-10 years
- 3) 11-15 years
- 4) 16-20 years
- 5) 21-25 years
- 6) 26-30 years
- 7) Over 30

181. My highest level of formal education achieved is \_\_\_\_\_.

- 1) Bachelor's Degree
- 2) Master's Degree
- 3) Doctorate

182. The annual operating budget for which I am responsible is \$ \_\_\_\_\_.

- 1) \$ 0 - 1,000
- 2) \$ 1,001 - 10,000
- 3) \$ 10,001 - 100,000
- 4) \$ 100,001 - 500,000
- 5) \$ 500,001 - 1,000,000
- 6) \$ over 1,000,000

# Appendix E: AFIT Data Collection Form

## AFIT DATA COLLECTION FORM

001	002	003	004
005	006	007	008
009	010	011	012
013	014	015	016
017	018	019	020
021	022	023	024
025	026	027	028
029	030	031	032
033	034	035	036
037	038	039	040
041	042	043	044
045	046	047	048
049	050	051	052
053	054	055	056
057	058	059	060
061	062	063	064
065	066	067	068
069	070	071	072
073	074	075	076
077	078	079	080
081	082	083	084
085	086	087	088
089	090	091	092
093	094	095	096
097	098	099	100

AFIT FORM 11E  
JAN 80

DO NOT MARK IN THIS AREA

01230



# Appendix E (Continued)

101	1234567	130	1234567	159	1234567	188	1234567
102	1234567	131	1234567	160	1234567	189	1234567
103	1234567	132	1234567	161	1234567	190	1234567
104	1234567	133	1234567	162	1234567	191	1234567
105	1234567	134	1234567	163	1234567	192	1234567
106	1234567	135	1234567	164	1234567	193	1234567
107	1234567	136	1234567	165	1234567	194	1234567
108	1234567	137	1234567	166	1234567	195	1234567
109	1234567	138	1234567	167	1234567	196	1234567
110	1234567	139	1234567	168	1234567	197	1234567
111	1234567	140	1234567	169	1234567	198	1234567
112	1234567	141	1234567	170	1234567	199	1234567
113	1234567	142	1234567	171	1234567	200	1234567
114	1234567	143	1234567	172	1234567		
115	1234567	144	1234567	173	1234567		
116	1234567	145	1234567	174	1234567		
117	1234567	146	1234567	175	1234567		
118	1234567	147	1234567	176	1234567		
119	1234567	148	1234567	177	1234567		
120	1234567	149	1234567	178	1234567		
121	1234567	150	1234567	179	1234567		
122	1234567	151	1234567	180	1234567		
123	1234567	152	1234567	181	1234567		
124	1234567	153	1234567	182	1234567		
125	1234567	154	1234567	183	1234567		
126	1234567	155	1234567	184	1234567		
127	1234567	156	1234567	185	1234567		
128	1234567	157	1234567	186	1234567		
129	1234567	158	1234567	187	1234567		

## Appendix F: GEM Course Titles

<u>GEM Course Titles</u>	<u>Credit Hours</u>
Elements of Financial and Managerial Accounting	2*
Introduction to AFIT Computer Systems	2*
Math Review for Engineers	2*
Research Orientation	0
Managerial Statistics	3
Theory and Practice of Professional Communication	3
Computer Programming	3
Organization and Management	3
Executive Engineering Management Symposia	0
Environmental & Energy Issues	4
Research Methods	2
Organizational Behavior	3
Managerial Statistics II	3
Independent Study	1
Executive Engineering Management Symposia	0
Engineering Management Information	3
Introduction. to Management Science	4
Elective	3
Independent Study	2
Executive Engineering Management Symposia	0
Contracting for Engineers	3
Engineering Management Techniques	4
Federal Financial Management	3
Elective	3
Independent Study	1
Executive Engineering Management Symposia	0
Independent Study	2
Seminar in Engineering Management	3
Elective	3
Executive Engineering Management Symposia	1
Independent Study	<u>6</u>
TOTAL CREDIT HOURS	72
Undergraduate Credit Hours	<u>-6</u>
Graduate Credit Hours	66

\* Indicates Undergraduate Credit

Appendix G: Responses to the Three Questions  
(By Military Rating)

<u>Academic Subject</u>	<u>How Much Do</u> <u>You Apply</u>		<u>How Much</u> <u>Should You</u>		<u>Importance</u>	
	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>
	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
Professional Ethics	5.36	5.74	5.80	5.92	6.11	6.33
Public Speaking	4.38	5.41	5.03	5.85	5.27	6.18
Leadership	4.57	5.40	5.09	5.73	5.40	6.13
Management Prin	4.72	4.91	5.26	5.66	5.48	5.96
Technical Writing	4.79	5.58	5.39	5.79	5.72	5.86
Personnel Mgt	4.92	4.72	5.36	5.20	5.83	5.86
Communication	4.65	4.91	5.22	5.59	5.49	5.67
Construction Mgt	5.08	4.14	5.48	4.46	5.98	5.45
Behavioral Sci	4.31	4.44	4.64	4.95	4.95	5.30
Project Mgt	4.94	4.81	5.57	4.94	5.84	5.28
Organizational Beh	4.02	4.33	4.79	4.85	4.81	5.23
Civil Engrg	3.38	3.98	3.78	4.25	4.06	5.22
Information Sys	3.32	3.97	4.02	4.80	4.25	5.08
Contract Policy	4.89	4.03	5.52	4.46	5.77	4.98
Group Projects	4.17	4.42	4.75	4.70	4.84	4.96
Master Planning	4.02	4.03	4.66	4.73	4.81	4.95
Building Pgm	4.57	3.83	5.23	4.38	5.45	4.90
Facility Oper	5.22	3.71	5.81	4.02	6.05	4.83
Budget Prep	5.00	3.73	5.39	4.40	5.58	4.81
Maintenance Mgt	5.08	3.31	5.69	3.74	5.95	4.70
Innovation Tech	3.51	3.96	4.23	4.41	4.44	4.54
Life Cycle Cost	3.86	3.25	4.77	3.91	5.03	4.51
Computer Systems	2.81	3.39	3.89	4.15	4.16	4.49
Interior Design	3.93	3.11	4.44	3.74	4.67	4.41
Building Fire Prot	5.02	3.36	5.39	3.91	5.66	4.31
Arch Designs	3.68	3.09	3.90	3.59	4.00	4.30
Laoor Relations	3.22	3.11	3.67	3.55	4.20	4.27
Computer Science	2.73	3.45	3.60	3.89	3.86	4.20
Decision Theory	3.32	3.40	4.03	4.09	4.05	4.14
Engineering Econ	4.19	3.03	4.65	3.32	4.92	4.09
Managerial Acct	3.97	3.09	4.64	3.71	4.89	3.95
Energy Mgt	4.77	2.95	5.46	3.33	5.75	3.94
Mechanical Engrg	4.95	2.81	5.43	3.33	5.54	3.93
Energy Eff Designs	4.40	2.87	4.95	3.27	5.35	3.92
Collective Barg	3.44	2.61	4.09	3.00	4.57	3.90
Electrical Engrg	4.41	2.67	5.00	3.32	5.20	3.88
Value Engrg	4.44	3.00	4.83	3.46	5.16	3.83
Safety Engrg	4.63	3.10	5.20	3.63	5.52	3.81
Public Policy	2.51	2.91	3.02	3.24	3.40	3.76
Quality Control	3.71	2.79	4.16	3.15	4.31	3.70
Installation &	4.19	2.70	5.03	3.05	5.28	3.66
Business Law	3.12	2.85	3.48	3.28	3.66	3.65
Financial Mgt	3.34	2.94	3.60	3.21	4.00	3.63

Appendix G (Continued)

<u>Academic Subject</u>	<u>How Much Do</u> <u>You Apply</u>		<u>How Much</u> <u>Should You</u>		<u>Importance</u>	
	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>	<u>Civ</u>	<u>Mil</u>
	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>	<u>Mean</u>
CAD / CAM	2.67	2.07	3.78	2.81	3.83	3.62
Strategic Plan	2.67	2.98	3.27	3.36	3.40	3.62
Network Modeling	3.07	2.70	3.77	3.31	3.63	3.57
Cost Accounting	3.74	2.85	4.29	3.28	4.46	3.50
Computer Room Des	3.29	2.52	4.09	3.00	4.23	3.45
R & D Management	2.83	2.64	3.32	2.88	3.43	3.44
Marketing	2.69	2.69	2.98	2.97	3.11	3.39
Industrial Engrg	3.54	2.41	4.08	2.84	4.21	3.35
Statistical Anal	2.64	2.38	2.74	2.75	2.90	3.23
Forecasting	3.18	2.32	3.71	2.90	3.88	3.08
Real Estate Acq	2.76	2.18	2.71	2.61	3.11	2.97
Entrepreneurship	2.40	2.44	2.56	2.52	2.93	2.88
Inventory Plan	3.27	2.05	3.95	2.15	4.02	2.86
Queuing Theory	2.53	2.10	2.70	2.51	2.84	2.84
Linear Program	1.90	1.71	2.68	2.26	2.35	2.14
Simulation Modeling	1.48	1.15	1.94	1.46	1.93	1.65

Appendix H: Importance & Need Ratings of Academic Subjects  
(By Military Rating)

<u>Academic Subjects</u>	<u>Importance</u>		<u>Need</u>	
	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>
Professional Ethics	6.33	6.11	0.18	0.45
Public Speaking	6.18	5.27	0.44	0.60
Leadership	6.13	5.40	0.42	0.49
Management Principles	5.96	5.48	0.75	0.53
Personnel Management	5.86	5.83	0.47	0.49
Technical Writing	5.86	5.72	0.21	0.37
Communication	5.67	5.49	0.62	0.66
Construction Management	5.45	5.98	0.32	0.61
Behavioral Science	5.30	4.95	0.49	0.38
Project Management	5.28	5.84	0.13	0.58
Organizational Theory	5.23	4.81	0.52	0.79
Civil Engineering	5.22	4.06	0.27	0.48
Information Systems	5.08	4.25	0.83	1.08
Contract Policy	4.98	5.77	0.43	0.38
Group Projects	4.96	4.84	0.26	0.40
Master Planning	4.95	4.81	0.68	0.69
Building Programming	4.90	5.45	0.55	0.65
Facility Operations	4.83	6.05	0.30	0.69
Budget Preparation	4.81	5.58	0.67	0.37
Maintenance Management	4.70	5.95	0.39	0.60
Innovation Techniques	4.54	4.44	0.47	0.17
Life Cycle Costing	4.51	5.03	0.63	0.86
Computer Systems Design	4.49	4.16	0.85	0.56
Interior Design	4.41	4.67	0.63	1.08
Building Fire Protection	4.31	5.66	0.51	-0.02
Architectural Design	4.30	4.00	0.50	0.49
Labor Relations	4.27	4.20	0.48	0.69
Computer Science	4.20	3.86	0.44	0.68
Decision Theory	4.14	4.05	0.69	0.71
Engineering Economics	4.09	4.92	0.30	0.45
Managerial Accounting	3.95	4.89	0.62	0.67
Energy Management	3.94	5.75	0.38	2.35
Mechanical Engineering	3.93	5.54	0.52	0.59
Energy Efficient Designs	3.92	5.35	0.41	0.37
Collective Bargaining	3.90	4.57	0.39	0.45
Electrical Engineering	3.88	5.20	0.65	0.54
Value Engineering	3.83	5.16	0.47	0.55
Safety Engineering	3.81	5.52	0.53	0.40
Public Policy	3.76	3.40	0.33	0.63
Quality Control	3.70	4.31	0.36	0.44
Installation & Space Mgt	3.66	5.28	0.35	0.40

# Appendix H (Continued)

<u>Academic Subjects</u>	<u>Importance</u>		<u>Need</u>	
	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>	<u>Mil</u> <u>Mean</u>	<u>Civ</u> <u>Mean</u>
Business Law	3.65	3.66	0.43	0.31
Financial Management	3.63	4.00	0.27	0.25
CAD / CAM	3.62	3.83	0.74	0.80
Strategic Planning	3.62	3.40	0.37	0.63
Network Modeling	3.57	3.63	0.60	0.80
Cost Accounting	3.50	4.46	0.43	0.56
Computer Room Design	3.45	4.23	0.48	0.57
R & D Management	3.44	3.43	0.24	0.72
Marketing	3.39	3.11	0.25	0.40
Industrial Engineering	3.35	4.21	0.43	0.22
Statistical Analysis	3.23	2.90	0.42	0.14
Forecasting	3.08	3.88	0.59	0.53
Real Estate Acq & Disp	2.97	3.11	0.43	0.84
Entrepreneur	2.88	2.93	0.05	0.46
Inventory Planning	2.86	4.02	0.10	0.73
Queuing Theory	2.84	2.84	0.41	0.20
Linear Programming	2.14	2.35	0.55	0.80
Simulation Modeling	1.65	1.93	0.30	0.48

# Appendix I: T-test

<u>Subject</u>	<u>T</u> <u>Value</u>	<u>P</u> <u>Value</u>
Queuing Theory	-0.01	0.995
R & D Management	-0.02	0.983
Business Law	0.03	0.975
Entrepreneurship	0.12	0.903
Personnel Management	-0.15	0.881
Network Modeling	0.18	0.860
Labor Relations	-0.19	0.851
Decision Theory	-0.28	0.783
Innovation Technique	-0.34	0.733
Group Projects	-0.35	0.728
Real Estate Acquisition & Disp	0.42	0.672
Master Planning	-0.47	0.639
Technical Writing	-0.49	0.625
Communication	-0.58	0.566
CAD / CAM	0.58	0.565
Strategic Planning	-0.59	0.556
Linear Programming	0.77	0.442
Marketing	-0.78	0.435
Interior Design	0.79	0.432
Computer Systems Design	-0.88	0.373
Architectural Design	-0.93	0.352
Computer Science	-0.94	0.347
Statistical Analysis	-0.97	0.335
Professional Ethics	-1.02	0.308
Public Policy	-1.06	0.293
Financial Management	1.13	0.260
Benavioral Science	-1.15	0.251
Simulation Modeling	1.21	0.231
Organizational Theory	-1.34	0.182
Life Cycle Costing	1.75	0.082
Quality Control	1.81	0.073
Building Programming	1.82	0.071
Collective Bargaining	1.82	0.071
Management Principles	-1.94	0.055
Project Management	1.95	0.053
Construction Management	2.08	0.040
Computer Room Design	2.17	0.032
Forecasting	2.22	0.028
Engineering Economy	2.49	0.014
Budget Preparation	2.66	0.009
Contract Policy	2.66	0.009
Industrial Engineering	2.70	0.008
Information Systems	-2.69	0.008
Leadership	-2.73	0.007
Cost Accounting	2.95	0.004

# Appendix I (Continued)

<u>Subject</u>	<u>T</u> <u>Value</u>	<u>p</u> <u>Value</u>
Inventory Planning	3.24	0.002
Managerial Accounting	3.09	0.002
Public Speaking	-3.54	0.001
Energy Management	6.04	0.000
Safety Engineering	5.52	0.000
Mechanical Engineering	5.30	0.000
Installation & Space Mgt	5.23	0.000
Energy Efficient Designs	4.71	0.000
Building Fire Protection	4.62	0.000
Value Engineering	4.44	0.000
Electrical Engineering	4.38	0.000
Facility Operations	4.22	0.000
Maintenance Management	4.15	0.000
Civil Engineering	-3.92	0.000



## Appendix J: Programs and Data

### SPSSX Program for Military Data

```

TITLE          THESIS RESEARCH
FILE HANDLE    THESIS / NAME = 'mil.dat'
DATA LIST      FILE = THESIS FIXED RECORDS = 3 /
                SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
                X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
                X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
                X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
                X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
                X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
                X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
                X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
                X81,X82,X83,X84,X85,X86,X87,X88,X89,X90,
                X91,X92,X93,X94,X95,X96,X97,X98,X99,X100,
                X101,X102,X103,X104,X105,X106,X107,X108,
                X109,X110,X111,X112,X113,X114,X115,X116,
                X117,X118,X119,X120,X121,X122,X123,X124,
                X125,X126,X127,X128,X129,X130,X131,X132,
                X133,X134,X135,X136,X137,X138,X139,X140,
                X141,X142,X143,X144,X145,X146,X147,X148,
                X149,X150,X151,X152,X153,X154,X155,X156,
                X157,X158,X159,X160,X161,X162,X163,X164,
                X165,X166,X167,X168,X169,X170,X171,X172,
                X173,X174,X175,X176,X177,X178,X179,X180,
                X181,X182
                (F8.0,52F1.0 / 60F1.0 / 60F1.0 / 10F1.0)

SET            BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X182 (9)

VALUE LABELS   X178 1 'UPPER MANAGEMENT'
                2 'MIDDLE MANAGEMENT'
                3 'FIRST LEVEL MANAGER'
                4 'ENGINEER' 5 'OTHER' /
X179 1 'LIEUTENANT' 2 'CAPTAIN'
                3 'MAJOR' 4 'LT COLONEL' /
X180 1 '0-6 YEARS' 2 '7-10 YEARS'
                3 '11-15 YEARS'
                4 '16-20 YEARS' 5 '21-25 YEARS'
                6 '26-30 YEARS' 7 'OVER 30 YEARS' /
X181 1 'BACHELOR' 2 'MASTER'
                3 'DOCTORATE' /
X182 1 '$0-1K' 2 '$1K-10K' 3 '$10K-100K'
                4 '$100K-500K' 5 '$500K-1M' 6 '$OVER $1M'

COMPUTE        NEED1 = X2 - X1
COMPUTE        NEED2 = X5 - X4
COMPUTE        NEED3 = X8 - X7

```

COMPUTE	NEED4 = X11 - X10
COMPUTE	NEED5 = X14 - X13
COMPUTE	NEED6 = X17 - X16
COMPUTE	NEED7 = X20 - X19
COMPUTE	NEED8 = X23 - X22
COMPUTE	NEED9 = X26 - X25
COMPUTE	NEED10 = X29 - X28
COMPUTE	NEED11 = X32 - X31
COMPUTE	NEED12 = X35 - X34
COMPUTE	NEED13 = X38 - X37
COMPUTE	NEED14 = X41 - X40
COMPUTE	NEED15 = X44 - X43
COMPUTE	NEED16 = X47 - X46
COMPUTE	NEED17 = X50 - X49
COMPUTE	NEED18 = X53 - X52
COMPUTE	NEED19 = X56 - X55
COMPUTE	NEED20 = X59 - X58
COMPUTE	NEED21 = X62 - X61
COMPUTE	NEED22 = X65 - X64
COMPUTE	NEED23 = X68 - X67
COMPUTE	NEED24 = X71 - X70
COMPUTE	NEED25 = X74 - X73
COMPUTE	NEED26 = X77 - X76
COMPUTE	NEED27 = X80 - X79
COMPUTE	NEED28 = X83 - X82
COMPUTE	NEED29 = X86 - X85
COMPUTE	NEED30 = X89 - X88
COMPUTE	NEED31 = X92 - X91
COMPUTE	NEED32 = X95 - X94
COMPUTE	NEED33 = X98 - X97
COMPUTE	NEED34 = X101 - X100
COMPUTE	NEED35 = X104 - X103
COMPUTE	NEED36 = X107 - X106
COMPUTE	NEED37 = X110 - X109
COMPUTE	NEED38 = X113 - X112
COMPUTE	NEED39 = X116 - X115
COMPUTE	NEED40 = X119 - X118
COMPUTE	NEED41 = X122 - X121
COMPUTE	NEED42 = X125 - X124
COMPUTE	NEED43 = X128 - X127
COMPUTE	NEED44 = X131 - X130
COMPUTE	NEED45 = X134 - X133
COMPUTE	NEED46 = X137 - X136
COMPUTE	NEED47 = X140 - X139
COMPUTE	NEED48 = X143 - X142
COMPUTE	NEED49 = X146 - X145
COMPUTE	NEED50 = X149 - X148
COMPUTE	NEED51 = X152 - X151
COMPUTE	NEED52 = X155 - X154
COMPUTE	NEED53 = X158 - X157
COMPUTE	NEED54 = X161 - X160
COMPUTE	NEED55 = X164 - X163

COMPUTE	NEED56 = X167 - X166
COMPUTE	NEED57 = X170 - X169
COMPUTE	NEED58 = X173 - X172
COMPUTE	NEED59 = X176 - X175
COMPUTE	AQUAN = MEAN (X1,X4,X7,X10,X13,X16,X19,X22)
COMPUTE	AQUAL = MEAN (X25,X28,X31,X34,X37,X40,X43)
COMPUTE	AFIN = MEAN (X46,X49,X52,X55,X58,X61,X64)
COMPUTE	APROJ = MEAN (X67,X70)
COMPUTE	AE1 = MEAN (X73,X76,X79,X82,X85)
COMPUTE	AE2 = MEAN (X88,X91,X94,X97,X100)
COMPUTE	AENGR = MEAN (AE1,AE2)
COMPUTE	AF1 = MEAN (X103,X106,X109,X112,X115)
COMPUTE	AF2 = MEAN (X127,X130,X133,X136,X139)
COMPUTE	AF3 = MEAN (X145,X152,X154,X157,X160)
COMPUTE	AF4 = MEAN (X166,X169,X172,X175,X178)
COMPUTE	AF5 = MEAN (X118,X121,X124,X127,X130)
COMPUTE	AFUN = MEAN (AF1,AF2,AF3,AF4,AF5)
COMPUTE	SQUAN = MEAN (X2,X5,X8,X11,X14,X17,X20,X23)
COMPUTE	SQUAL = MEAN (X26,X29,X32,X35,X38,X41,X44)
COMPUTE	SFIN = MEAN (X47,X50,X53,X56,X59,X62,X65)
COMPUTE	SPROJ = MEAN (X68,X71)
COMPUTE	SE1 = MEAN (X74,X77,X80,X83,X86)
COMPUTE	SE2 = MEAN (X89,X92,X95,X98,X101)
COMPUTE	SENGR = MEAN (SE1,SE2)
COMPUTE	SF1 = MEAN (X104,X107,X110,X113,X116)
COMPUTE	SF2 = MEAN (X128,X131,X134,X137,X140)
COMPUTE	SF3 = MEAN (X152,X155,X158,X161,X164)
COMPUTE	SF4 = MEAN (X125,X128,X131,X134,X137)
COMPUTE	SF5 = MEAN (X119,X122,X125,X128,X131)
COMPUTE	SFUN = MEAN (SF1,SF2,SF3,SF4,SF5)
COMPUTE	IQUAN = MEAN (X3,X6,X9,X12,X15,X18,X21,X24)
COMPUTE	IQUAL = MEAN (X27,X30,X33,X36,X39,X42,X45)
COMPUTE	IFIN = MEAN (X48,X51,X54,X57,X60,X63,X66)
COMPUTE	IPROJ = MEAN (X69,X72)
COMPUTE	IE1 = MEAN (X75,X78,X81,X84,X87)
COMPUTE	IE2 = MEAN (X90,X93,X96,X99,X102)
COMPUTE	IENGR = MEAN (IE1,IE2)
COMPUTE	IF1 = MEAN (X105,X108,X111,X114,X117)
COMPUTE	IF2 = MEAN (X129,X132,X135,X138,X141)
COMPUTE	IF3 = MEAN (X153,X156,X159,X162,X165)
COMPUTE	IF4 = MEAN (X123,X126,X129,X132,X135)
COMPUTE	IF5 = MEAN (X120,X123,X126,X129,X132)
COMPUTE	IFUN = MEAN (IF1,IF2,IF3,IF4,IF5)
COMPUTE	NQUAN = MEAN (NEED1 TO NEED8)
COMPUTE	NQUAL = MEAN (NEED9 TO NEED15)
COMPUTE	NFIN = MEAN (NEED16 TO NEED22)
COMPUTE	NPROJ = MEAN (NEED23,NEED24)
COMPUTE	NENGR = MEAN (NEED25 TO NEED34)

```

COMPUTE      NFUN = MEAN (NEED35 TO NEED59)

FREQUENCIES  VARIABLES = X178 (1,5) X179 (1,4) X180 (1,7)
              X181 (1,3) X182 (1,6) /
              STATISTICS = DEFAULT

FREQUENCIES  VARIABLES = NEED1 TO NEED59 X3 X6 X9 X12 X15
              X18 X24 X27 X30 X33 X36 X39 X42 X45 X48 X51
              X54 X57 X60 X63 X66 X69 X71 X73 X75 X78 X81
              X84 X87 X90 X93 X96 X99 X102 X105 X108 X111
              X114 X117 X120 X123 X126 X129 X132 X135 X138
              X141 X144 X147 X150 X153 X156 X159 X162 X165
              X168 X171 X174 X177 AQUAN AQUAL AFIN APROJ
              AENGR AFUN SQUAN SQUAL SFIN SPROJ SENGR SFUN
              IQUAN IQUAL IFIN IPROJ IENGR IFUN NQUAN
              NQUAL NFIN NPROJ NENGR NFUN /
              FORMAT = ONEPAGE /
              STATISTICS = RANGE MEAN MEDIAN STDEV
              VARIANCE /

```

### Military Data

```

00001234111111111666111111111111555555444222666665555552222
221114446665554445555544444111333222221114442221114442222
225556665552221114442225553335552221112224441112221114445556
6622242226
00001237122111122222          244777567445332555233355111222
22343354    243254222457          245565          324255
    355557777255111221222434    667    332666244225121          2
44    22126
00001238334111111234111    111111666444333    22    444223
    111    111 33111          333
    444          333
    1212
0000123933366711333333224224465575574563334471153562251151
161163352251164473353361131131151131136663356661135556661131
136666667775562241141133441124441151152256671121111134461161
1611322226
000012401111121112442333344467757777776667775773664555764653
35554777777776775342251141141143352244572243343255675672553
37133133655777111112121113345771351151333571155771133673772
3622623326
000012412223341114442223331111114444443344454474674673662222
222224553662223542222552562443343554664774553442334453323563
3344533645633333224223442223363353343363563332233353363363
3633422226
000012421251251352454551251151354554554554554454554554452552
454554552353452343443352352353352352354553453452353554552452
35345355556455455455235355455666235225455235235455225225253
3522522326

```

00001243111114 2341131131121144574574571246677772353341141  
 171144454441144465572271141141161152277772251141167777772257  
 747777777711113113114666117771451451134471131131122271161  
 1711522126  
 0000123411111111666111111111115555554442226666665555552222  
 2211144466655544455555544444111333222221114442221114442222  
 225556665552221114442225553335552221112224441112221114445556  
 6622242226  
 0000123712211112222 2447775674453325552333551111222  
 22343354 243254222457 245565 324255  
 35555777255111221222434 667 332666244225121 2  
 44 22126  
 00001238334111111234111 111111666444333 22 444223  
 111 111 33111 333  
 444 333  
 1212  
 00001239333667113333332242244465575574563334471153562251151  
 161163352251164473353361131131151131136663356661135556661131  
 136666667775562241141133441124441151152256671121111134461161  
 1611322226  
 0000124011111211124423334446775777776667775773664555764653  
 3555477777776775342251141141143352244572243343255675672553  
 37133133655777111112121113345771351151333571155771133673772  
 3622623326  
 000012412223341114442223331111114444443344454474674673662222  
 22224553662223542222552562443343554664774553442334453323563  
 334453364563333332242223442223363353343363563332233353363363  
 3633422226  
 000012421251251352454551251151354554554554554454554554452552  
 454554552353452343443352352353352352354553453452353554552452  
 353453555564554554552353554556662352254552352354552252252253  
 3522522326  
 00001243111114 2341131131121144574574571246677772353341141  
 171144454441144465572271141141161152277772251141167777772257  
 747777777711113113114666117771451451134471131131122271161  
 1711522126  
 00001244222234112567567344111456677566666666775163664664665  
 664462244466665565663352242242242242232342333452335666662252  
 2477776777766656622245676756677726115556777333333334462262  
 2522352226  
 00001245334566144443111555222355342231121111556227456111111  
 21111111221222 777776773331111116566564221113232116666665232  
 11566666666111211311566311111666666666333666111113226263333  
 3321142226  
 00001236 4111 323522222 3113666666776333777666333 4 4  
 5 5 4 5 5 5236 7 6 6 6 5 5113 5 6224334 3  
 366677777 4 4 4 4445 3777446114334 3 4 4 4 6 6  
 6 622121  
 0000123512112111111233111111115676767774655666665554443431  
 212224443323435556764442222223334445554614333644444613211211  
 11777777775557773334446675447775556556773335444332224445554  
 4444422126

00001246655556 666225115 556667557777 777 5765665  
77322777 5574475564473113114441141115671111141136676671141  
115567777771131131141142253326631111142221142241121141162363  
3611223326  
000012512233351244572242245672355675564562356676774553453552  
242343772342343343345575675664456776772676662242552672451132  
256676777775673442241144561157777772371262377771153343355665  
6723452123  
000012521225561225552331112221226674575552253466662332332335  
555552672332457775676673363361242452343566674672233662451451  
356776674542551235661233342236675675552337777771222347774674  
6733532123  
000012532222321223332222112111116666666664447777774335245254  
344343445655557777775561311312213332331312324443332113352452  
32677556556212111222111555222667666556324676676332233333554  
444442222  
000012563532551115651311311111143644653672644655676762321134  
44111667577444672333431411412423423431112311311331114751462  
42265577577143355111111477344567111111113643537773555771264  
4446522226  
000012571421421113631321111111135752553551114555552551533445  
562551237772665552567771441441771661552771441442443773771331  
3357777777733355511155533333777333666554447771114447771117  
7744422126  
000012591222221222223331222352225666666665557776666665556665  
665667773553555665553233335445442223331225552332223561561222  
22566246333222566466225333113336225225253332221222241125555  
5533313126  
000014611113541111231321211112342431111111112531422531111112  
441223522332445542422323334341321322443311212432441311311322  
334533515632321311424635642424541311312433331221312434542324  
5323322126  
000018111112111111331111111111113554453452223463341353452224  
45111111335555666333447221337114445555145244356233333665 1  
14356567667355344 354 6673341131117777772221137776677  
7744522226  
0000189411111111111111111111111144344233555555546662432222  
332222221131132225663331111111221111114231111111111222221111  
11455677777111121111114551112221111111111111111111111111111  
1111122121  
000025724774771114444774444441114774774774774774774774774774  
774774777774777777777774444477777777777444447774114447777  
7747747747744477741141147777777711111777777777177777777777  
7777732126  
000025751111121111113433333442115543221111115565565433322226  
66321122444666666421777677777432655777556766767672226773443  
545557777775544466743311111677667666676774775554547767777  
7777722126  
000025771215551115664551111115666766655551116665545544331111  
12112445324233334455533111131111111313556223111115565564444  
23556544556111114445565651117771211111113331241115563451113  
3411123121

83

00002633111333111464222221222224653334442225765554441112222  
2222246522222333666333333333443333322222223332224662225  
55676777772222233344455533366766667655555333222225556666  
6666612126  
000026341112211112321111111111115673335661117777773332231111  
1111144411111111666111111111111111266111111111431111111  
11576677111411111111156411154711111113265611111111111111  
1111123125  
000026352313461115774763335777775774544763335773655664664663  
443443444653446765773543653547523543335765774544557336553333  
4357755753333222465332454446774543545674543543235656565774  
6546522326  
000026371312321334541112221113432463463442234663463351121223  
553452255663554552424352242241113643442241123453344564661242  
3433436656622322224233454224455223222223354552443443352242  
222222221  
000026422225242123343235134134225775665574456777777573663444  
1231157755526524425665466366445456256 14557763446423333111  
116776667772113554553114673117775773773337775773665556774776  
7746622226  
000026431113341156774443464463363374475562455671374552113323  
331115561342255566665553353352242262263353553322234434461151  
1167777744533366643522233322166733433433333333333333564454  
442222226  
000026451113221112221221121112344573463451113333455552331133  
371131331232252243353351131131133332232241122231134463362441  
112354464442341111241133331133371261151123552333331121231131  
1311322225  
000026462225551114542213345562227777777775437775665665645443  
3357677766677777755755655655655655656664465563465676677777  
7743455655611133533333333222577554445456664661117776667775  
5544442126  
000026472224661111233551113332226666665557777777775554444442  
5423434466622266655557223222222223334453443443334455551141  
24234567777123125123123123333456114113114344453114444777555  
5555512126  
000026481112421112221111421111115763435652226777776774542534  
642225665562324553324672352552334565665554445556563334564775  
6666666777355233566677455667777772462436775551115667775215  
2152122226  
000026493225431 15333 13 12115 16776665663225556776773114117  
563113216777776555556773453454335564564464553445664575562442  
335665677674453223333445542226663322214324553552443444664665  
6656622226  
000026513546663435656664544563544774676665646666577766655645  
55564666777555777566 777 3576775655656655655655674656  
64777675666222455666575666111777223222443666567343666777 546  
7735432126  
000026582224442226775554443333334454355564447771166664452213  
35445555777446777777775674561125565566676675545546676673373  
37777777776677776676675564447773351115552266672242246673252  
2511152221



000026611342 1 21 235612 3472353 7 4 475663 11 1124  
 47 2 1 44 3 12 246111111113335457111  
 1 35676771121 2241125 71 2446 131121133451 41132352251 51  
 2511312123  
 000026831212321221111111321122133453434352224463453354665543  
 33243555567323444355555666666232343566343666676767354222324  
 4467677777554333443332541217675554443335556665652227666667  
 7776732226  
 00002685 554 666655  
 664776666 646434  
 77777 544 777  
 33121  
 000026861112141111241141141142244454455771146777771241141152  
 26114334114114114666117111114114114114224111141144241461171  
 14777777111141111143245671117771141113351142261141141141141  
 1411453321  
 00002700121111 164166111111565766666661227773772662663667  
 245551665773344214665462442441112342443771114443663774771111  
 664775775772444442443773662117771462462774673333773774663133  
 1334352222  
 00002703121143154344111111113445673335661115666667664551113  
 33111555465444444566455444444111221222 4331111114435553331  
 1166666666 22222 333 666443454333554442331114542111  
 1134322224  
 000027042122221114473371111112355675675672373365577772243354  
 45226335667445336557555222223337772232452232223341116662231  
 11677667667555455223111457357457222222222232223331123352221  
 1233422224  
 000027061222321221211111111111222121111121111112322321215  
 321112222224322211144433333322233322212234333322222331112  
 22232333344222111122111233222345222111232345444223224552323  
 4323242221  
 00002707114337111557127777117557777777777675777657777777777  
 47777327777446777777437111111153241137772224452167777776667  
 11777777777434225114112546317777214161147772252222243471142  
 2422652126  
 00002709111667111335112114114334457124224337777446536555121  
 24447447336225647777141121131131324424557445333124444555245  
 3377777777722323322444457733377713513512344455522224357667  
 5555552221  
 000029681411361117771771671161561571571571537772771774777777  
 371274771171376775771171171171371171175771171171176777777777  
 1737777777711711511713577713577711711711117117111141171177  
 17117  
 000041033335551113332223333332226665555554445555553333333333  
 333334444444466644455544444444455544444444222 333334443332  
 2233355555222333222223332223332222222222333222226663333  
 3322213326  
 000041042223553325554443434443335654445553445776775664444444  
 544444554444665555666774544544543443443444545664544445665555  
 55577677666333333663555663337775664664444663663322433664664  
 6535413126

000044384664661125672224444352467775576674456667772256666665  
675565562264665565445557556556556446556445552234451124561234  
545563445663452255674465674565665552241156665652232267776776  
6722522226  
000045072411112114114114112112116664144341116365243112143111  
11521333311311631535524 5241211115461115  
34711666111657515444 4221116471111113241114261113116166466  
45555  
00004727121111 131131155 1324752533762116773752122334541  
32354133354354254132257157157133235277111152111173111167  
677122243 153152 111 677152 11111 4551224  
7717522126

AD-A107 036

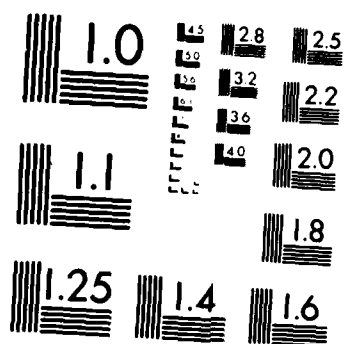
AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN  
FACILITIES ENGINEERING(U) AIR FORCE INST OF TECH  
WRIGHT-PATTERSON AFB OH SCHOOL OF SYST.. D H KREAG  
SEP 87 AFIT/GEN/LSN/87S-14 F/G 5/6

2/2

UNCLASSIFIED

NL





MICROCOPY RESOLUTION TEST CHART  
NATIONAL BUREAU OF STANDARDS-1963-A

SPSSX Program for Civilian Data

```
TITLE          THESIS RESEARCH
FILE HANDLE    THESIS / NAME = 'civ.dat'
DATA LIST      FILE = THESIS FIXED RECORDS = 3 /
               SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
               X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
               X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
               X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
               X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
               X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
               X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
               X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
               X81,X82,X83,X84,X85,X86,X87,X88,X89,X90,
               X91,X92,X93,X94,X95,X96,X97,X98,X99,X100,
               X101,X102,X103,X104,X105,X106,X107,X108,
               X109,X110,X111,X112,X113,X114,X115,X116,
               X117,X118,X119,X120,X121,X122,X123,X124,
               X125,X126,X127,X128,X129,X130,X131,X132,
               X133,X134,X135,X136,X137,X138,X139,X140,
               X141,X142,X143,X144,X145,X146,X147,X148,
               X149,X150,X151,X152,X153,X154,X155,X156,
               X157,X158,X159,X160,X161,X162,X163,X164,
               X165,X166,X167,X168,X169,X170,X171,X172,
               X173,X174,X175,X176,X177,X178,X179,X180,
               X181,X182,X183
               (F8.0,52F1.0 / 60F1.0 / 60F1.0 / 11F1.0)

SET            BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X183 (9)

VALUE LABELS   X178 1 'UPPER MANAGEMENT'
                2 'MIDDLE MANAGEMENT'
                3 'FIRST LEVEL MANAGER'
                4 'ENGINEER' 5 'OTHER' /
X179 1 'MANUFACTURING'
                2 'NONMANUFACTURING' /
X180 1 '0-6 YEARS' 2 '7-10 YEARS'
                3 '11-15 YEARS' 4 '16-20 YEARS'
                5 '21-25 YEARS' 6 '26-30 YEARS'
                7 'OVER 30 YEARS' /
X181 1 'HIGH SCHOOL' 2 'ASSOCIATE'
                3 'BACHELOR' 4 'MASTER' 5 'DOCTORATE' /
X182 1 'ENGINEERING' 2 'MANAGEMENT'
                3 'OTHER' /
X183 1 '$0-100K' 2 '$100K-500K' 3 '$500K-1M'
                4 '$1M-5M' 5 '$5M-10M' 6 '$10M-15M'
                7 '$OVER $15M'

COMPUTE        NEED1 = X2 - X1
COMPUTE        NEED2 = X5 - X4
COMPUTE        NEED3 = X8 - X7
```

COMPUTE	NEED4 = X11 - X10
COMPUTE	NEED5 = X14 - X13
COMPUTE	NEED6 = X17 - X16
COMPUTE	NEED7 = X20 - X19
COMPUTE	NEED8 = X23 - X22
COMPUTE	NEED9 = X26 - X25
COMPUTE	NEED10 = X29 - X28
COMPUTE	NEED11 = X32 - X31
COMPUTE	NEED12 = X35 - X34
COMPUTE	NEED13 = X38 - X37
COMPUTE	NEED14 = X41 - X40
COMPUTE	NEED15 = X44 - X43
COMPUTE	NEED16 = X47 - X46
COMPUTE	NEED17 = X50 - X49
COMPUTE	NEED18 = X53 - X52
COMPUTE	NEED19 = X56 - X55
COMPUTE	NEED20 = X59 - X58
COMPUTE	NEED21 = X62 - X61
COMPUTE	NEED22 = X65 - X64
COMPUTE	NEED23 = X68 - X67
COMPUTE	NEED24 = X71 - X70
COMPUTE	NEED25 = X74 - X73
COMPUTE	NEED26 = X77 - X76
COMPUTE	NEED27 = X80 - X79
COMPUTE	NEED28 = X83 - X82
COMPUTE	NEED29 = X86 - X85
COMPUTE	NEED30 = X89 - X88
COMPUTE	NEED31 = X92 - X91
COMPUTE	NEED32 = X95 - X94
COMPUTE	NEED33 = X98 - X97
COMPUTE	NEED34 = X101 - X100
COMPUTE	NEED35 = X104 - X103
COMPUTE	NEED36 = X107 - X106
COMPUTE	NEED37 = X110 - X109
COMPUTE	NEED38 = X113 - X112
COMPUTE	NEED39 = X116 - X115
COMPUTE	NEED40 = X119 - X118
COMPUTE	NEED41 = X122 - X121
COMPUTE	NEED42 = X125 - X124
COMPUTE	NEED43 = X128 - X127
COMPUTE	NEED44 = X131 - X130
COMPUTE	NEED45 = X134 - X133
COMPUTE	NEED46 = X137 - X136
COMPUTE	NEED47 = X140 - X139
COMPUTE	NEED48 = X143 - X142
COMPUTE	NEED49 = X146 - X145
COMPUTE	NEED50 = X149 - X148
COMPUTE	NEED51 = X152 - X151
COMPUTE	NEED52 = X155 - X154
COMPUTE	NEED53 = X158 - X157
COMPUTE	NEED54 = X161 - X160
COMPUTE	NEED55 = X164 - X163

```

COMPUTE      NEED56 = X167 - X166
COMPUTE      NEED57 = X170 - X169
COMPUTE      NEED58 = X173 - X172
COMPUTE      NEED59 = X176 - X175

COMPUTE      AQUAN = MEAN (X1,X4,X7,X10,X13,X16,X19,X22)
COMPUTE      AQUAL = MEAN (X25,X28,X31,X34,X37,X40,X43)
COMPUTE      AFIN = MEAN (X46,X49,X52,X55,X58,X61,X64)
COMPUTE      APROJ = MEAN (X67,X70)
COMPUTE      AE1 = MEAN (X73,X76,X79,X82,X85)
COMPUTE      AE2 = MEAN (X88,X91,X97,X100)
COMPUTE      AENGR = MEAN (AE1,AE2)
COMPUTE      AF1 = MEAN (X103,X106,X109,X112,X115)
COMPUTE      AF2 = MEAN (X127,X130,X133,X136,X139)
COMPUTE      AF3 = MEAN (X152,X154,X157,X160,X163)
COMPUTE      AF4 = MEAN (X121,X124,X145,X148,X172)
COMPUTE      AF5 = MEAN (X118,X142,X166,X169,X175)
COMPUTE      AFUN = MEAN (AF1,AF2,AF3,AF4,AF5)

COMPUTE      SQUAN = MEAN (X2,X5,X8,X11,X14,X17,X20,X23)
COMPUTE      SQUAL = MEAN (X26,X29,X32,X35,X38,X41,X44)
COMPUTE      SFIN = MEAN (X47,X50,X53,X56,X59,X62,X65)
COMPUTE      SPROJ = MEAN (X68,X71)
COMPUTE      SE1 = MEAN (X74,X77,X80,X83,X86)
COMPUTE      SE2 = MEAN (X89,X92,X95,X98,X101)
COMPUTE      SENGR = MEAN (SE1,SE2)
COMPUTE      SF1 = MEAN (X104,X107,X110,X113,X116)
COMPUTE      SF2 = MEAN (X128,X131,X134,X137,X140)
COMPUTE      SF3 = MEAN (X152,X155,X158,X161,X164)
COMPUTE      SF4 = MEAN (X119,X125,X149,X173,X176)
COMPUTE      SF5 = MEAN (X122,X143,X146,X167,X170)
COMPUTE      SFUN = MEAN (SF1,SF2,SF3,SF4,SF5)

COMPUTE      IQUAN = MEAN (X3,X6,X12,X15,X18,X21,X24)
COMPUTE      IQUAL = MEAN (X27,X30,X33,X36,X39,X42,X45)
COMPUTE      IFIN = MEAN (X48,X51,X54,X57,X60,X63,X66)
COMPUTE      IPROJ = MEAN (X69,X72)
COMPUTE      IE1 = MEAN (X75,X78,X81,X84,X87)
COMPUTE      IE2 = MEAN (X90,X93,X96,X99,X102)
COMPUTE      IENGR = MEAN (IE1,IE2)
COMPUTE      IF1 = MEAN (X105,X108,X111,X114,X117)
COMPUTE      IF2 = MEAN (X129,X132,X135,X138,X141)
COMPUTE      IF3 = MEAN (X153,X156,X159,X162,X165)
COMPUTE      IF4 = MEAN (X120,X126,X150,X174,X177)
COMPUTE      IF5 = MEAN (X123,X144,X147,X168,X171)
COMPUTE      IFUN = MEAN (IF1,IF2,IF3,IF4,IF5)

COMPUTE      NQUAN = MEAN (NEED1 TO NEED8)
COMPUTE      NQUAL = MEAN (NEED9 TO NEED15)
COMPUTE      NFIN = MEAN (NEED16 TO NEED22)
COMPUTE      NPROJ = MEAN (NEED23,NEED24)
COMPUTE      NENGR = MEAN (NEED25 TO NEED34)

```

```

COMPUTE          NFUN = MEAN (NEED35 TO NEED59)

FREQUENCIES      VARIABLES = X178 (1,5) X179 (1,2) X180 (1,7)
                  X181 (1,5) X182 (1,4) X183 (1,7) /
                  STATISTICS = DEFAULT

FREQUENCIES      VARIABLES = NEED1 TO NEED59 X3 X6 X9 X12
                  X15 X18 X24 X27 X30 X33 X36 X39 X42 X45
                  X48 X51 X54 X57 X60 X63 X66 X69 X71 X73
                  X75 X78 X81 X84 X87 X90 X93 X96 X99 X102
                  X105 X108 X111 X114 X117 X120 X123 X126
                  X129 X132 X135 X138 X141 X144 X147 X150
                  X153 X156 X159 X162 X165 X168 X171 X174
                  X177 AQUAN AQUAL AFIN APROJ AENGR AFUN
                  SQUAN SQUAL SFIN SPROJ SENGSR SFUN IQUAN
                  IQUAL IFIN IPROJ IENGR IFUN NQUAN NQUAL
                  NFIN NPROJ NENGR NFUN /
                  FORMAT = ONEPAGE /
                  STATISTICS = RANGE MEAN MEDIAN STDEV
                  VARIANCE /

```

### Civilian Data

```

000014593445661235773663543341225655554442445553562563442333
531223635773764663557667667664437667663467666667666466463567
665557654427541214542424651217772442642237677672533647675667
67666215416
000014582211111112234511111111344441111111345674564564674
777777777774443342223445777773336662772446343441221241132671
772443774771334662341231221226774565771116776771336774776777
77233115314
0000145413 334 344556244345 345 344 221556244355256
466566266466366344466466365344344 566244355
646624444444 456334 356456366223456466 36646666 4
66466213214
000014511314551113442221113662564445556672436675663442553453
67134444555266667455234567466144134344222553444661221221443
433332245551111113332322221115564456661222334441134565677777
77377214414
000014461115771464564561351111356664557772347775672224553447
77245455455567777566555555553545554441774445575552474661661
356663567771333467774552471175552462461237775574563452333441
22244224412
000014432441231233332333342452224453443342336676775564454456
77556777777556777667556556556334556445677777777775565562226
6777777777744544566644566744577744433355677777667777777777
77777112414
000014402232231233345552225552226674444674675674774774564563
563565674564564443444444442442442443442334774665552233442332
224675774772332224562222332226773443443444675772333565666666
66566222314

```



91

00001390254111 267143 132 3521114563443442442541311212  
45 3 1144123577234464464666444 12311513675665661421211212  
31444556265 1 111 1 1131 445 1131 1564466 1214454464  
45677314144  
000013861214431113325542125655457774446651216557777776665665  
6655577777777777666444444445555556666667776665552223332226  
667776666664443335444446661116777677744477777546767777777  
77777224324  
000013852432321112222221111113443333334342225453335453332222  
22222545434444656656434767656323545434212666666767212 2 17  
576566566663222 2222222546 117674342222246567671116567777777  
7776732331  
000013845467653236675677463317226555454123546577776553544537  
554547777777777777565447777775456667577575775557777775347777  
775544236774674453136573213226565673465457777775227567777777  
77777211316  
000013833432233233445452334543235454654453336677673454564446  
76433455567377445466445444444554444445544444566465456676675  
55656336457555445667666557355566555553566676661144345675553  
55456312312  
000013811212561113441111112441114663554441115575552213434435  
55111554233143 46635411156636647723344445535622224422324545  
677233444 455222243111444111132231243445 6663456772  
46455213414  
00001374122221111111111111321114553333332112334552211221112  
2211144534433222233445654653443334543444443334443232222431  
443444444541111111223322321113332223331114543541213545665654  
66455223314  
000013722322651112324553335664445666775672446776765556774447  
775557775665557775554447777772334447771337773336663554554544  
447777677774441113335777772227774444443337777774447777777777  
77555317215  
000013681125761441231131341363561273676671175371265673371143  
371271263572254676672356664672451343672575672572573672571361  
366673675571342575671463561165672261141136665551136675675675  
67567411412  
000013672222331112222222223331114444554552226676676675666667  
672236667776676776664446667775555556662227776665551112222224  
44666766777666222445221222 777666666666666666667777777777  
77777212314  
000013631112441112451111116774446776776771117777774774444444  
222444441115771112221114444444771111116661114441114466772211  
114444674672222223441113574674675664672223442442221111237777  
77235216327  
000013582543431331434641442661434762654662555775662553661552  
66144376 65155255365133466466366233444133465 55154232266 541  
44366576577 21466144 476 666566565 2266566 23664665664  
66254226316  
000013541114551212323321212321214433434551114555663334443333  
431214442323437777773443443553331214551112326664443332221112  
2267734367734422211111121111777343111116773451111215666667  
77345312314

000013531321211111324445555566675565657772335643556665664546  
76322242565322343676333777777775554441415552327664433431211  
213554544564542325653335661214552226763223335651216766552222  
22332212311  
00001352 111111333222111111111333333111113351151152223333  
335555566666777333222777222111333555247777777771112221112  
223442445671221112221112221114571441452444473371113373371442  
44357417313  
00001350222222111777312111322556566666661114345556661111116  
662333337776666667775556667775544443235556663336666776675563  
44556445445111115564444451114443333341113351111114454455565  
55557211242  
00001344555666554777556666766544777567666556766756767777777  
6775677755555677666344444333567444333444333666444444453333  
33333667677667566555556665556663336673476663333346664565565  
55335112332  
000013431223331111112223331112223443332225556663143333333333  
333333334441115552221117772223331111115553334446661111113337  
771111113333331115555552222222223331111113336661111227772224  
44555416144  
00001335232232111233111233666222666355455 5777772444667774  
554557772556666774653555665662333654662446773765772223333652  
22466466677333 444666366111777244 265677771223663566776  
77457211312  
000013301445661336676666665553336774666677777777776666666675  
674665663663665775675253651666661333561673776772561771771674  
446665563773771232572556774475671351473572674777364774663664  
77477213314  
000013261112222226653564443152356776775775466777777775773454  
77447657436436667567226226226262151143373465472172265473271  
115675773372154473562455773556661257773457572264353463262363  
46466124315  
000013223444431115651113213542225664442332225565665555455564  
33333666343435662223446665661112224452225666665661115555663  
3356644421111111556355444111666 455555555 6665557776  
66555215214  
000013214665775555667774467775565566675556676675564555566676  
66555667566556677566555777665666554455566676676675555554443  
345555445455222335675563442236672245563456676773235666667777  
77676155143  
000013202554662441442551333651326773674661332445665554565664  
443225666674456664334346664445554335442576772455662672442564  
556666666775454455673344554556775555553445675663455666775666  
77555215314  
00001319222556 5554564444665555556665563325566665555556665  
554436666675556665554445554553325555562335565555662224453555  
55556554556233222444333445 666222 2226665564446665665666  
66666217415  
00001318352556244666666344566332666666656343666666455555555  
663336665563553453445555553444445564552444554555661232333553  
55666666663443443442442331335662442552554556666664555666666  
66466211326

000013151225663335566662234445556664665445555664564444564564  
45556555666456667344346344444444443343334566673343334444343  
34444345433555555444334445336566545444444667554444446673444  
45334215331  
00001314111112111777444111111117777744421117767755677771115  
555557775555577777711155555222444666111144111111551441111  
33777777551111111144477733377733311411377777333777777777  
77777125324  
00001313232344 6666664446435566766777675445776775655666666  
565336666654546776775677675765346767776667776667676453432516  
45677565757656533422422555211677223 677777 6767576666  
77666215315  
000013094554365654556546235556565564665665653555456665666632  
266556546656534345654354545554556553435554565656645777777211  
777777444555622565755544456644455655777777655655454777655567  
77733322275  
0000130511 131 11333111 11 11 11453222333 112224452224442233  
342224455563345673334663664552455663562554652544562532221554  
66224354556335 1233113445 1667334334 16666663333566674675  
67467217315  
0000130012111111123312 244 455222356 3443443343433423  
45 45555344466455233566555 233344344232222321211211221  
22355333444122 133 122122 133344 231336766776  
77343224213  
0000129311 1 3235556245456 256675 65 6567 566 75675675564  
56334 7767756746744556777777566456567357456456567256145 1  
4514746734713513435 14 467 567345345 34257456 14656 5 5  
567221144  
00001290111144111223111111261114675551112342342344564564555  
552236676665555566666666666222666666246456555552342222466  
666666666611111555555551116663333311166666666666666666666  
66666117247  
00001286556322111222555111555335556444555444446773333332226  
44111777667556667221122777777111222677667675777777772224575  
6756633456644411222111111115664446661116666661117777777777  
77777212113  
00001285111 11 111111111111115663331111112427776432432222  
2111126615611112211112212211122 11133111333133122 1  
11111 221 333211111 222666 1224336666  
66366323143  
000012831113221112212442222421115547776664327777776566663552  
255353256365467776664336464463443332221116673117562566772224  
22777777777557666667211444313777777776367776553114337777777  
77656224214  
00001282121232 121 1211111321112221112332211212223332  
3211144433222123212123334434434334343111344343344111233 1  
2123223233312111 111121142132333343 2 32131233 213542433555  
65555214313  
000012792325541223442216325435214433223221115436555444335436  
446436557677667665546557666655546556664436547676664434335547  
666556545555444325433226554336544324333227777666666557777667  
77766215312

000012743331321114571441113561115674776771565667774775772776  
 772546775773774772663554664552225775771775676772551461441773  
 775773662461441111111111331117772343331225777771111414767775  
 77777224334  
 000012682422531216662431222542435665652551116766664553453654  
 653236665652444656662435656662442224543656665556661445551323  
 546662334653332224331115661224652325651112224651114652225665  
 66565213315  
 000012652442331113545561232432464572424561223555562332332345  
 563555562563554674451234564563332345563424674455561222343566  
 6666755666632312225655555112457122222343565551243455554566  
 67667216316  
 000012633234562226664452324553324565565673325566774434344344  
 364355453454566674443437674663323324456676564346677775467776  
 676576776776674325437674446577776456454225456575346676676777  
 77667311314  
 00001261        3 1426662235555662224333454554443454 53343453 55  
 54 4544577 7777 666666555555665777777444 6 5 5662242 34457  
 776666676672 32 26663334442226 61111112 7777772237777775567  
 77777412213  
 00001260 21242111443111 123 125 23 235 252542432431  
 443333451115551111412437773442222311421215756654743746765741  
 52256174576 32 34453 41332 32777256677 4 7777771116667777777  
 77666414311

SPSSX Program for T-Test

```
TITLE          THESIS RESEARCH
FILE HANDLE    THESIS / NAME = 'sur.dat'
DATA LIST      FILE = THESIS FIXED RECORDS = 3 /
                SURVEYNO,X1,X2,X3,X4,X5,X6,X7,X8,X9,X10,
                X11,X12,X13,X14,X15,X16,X17,X18,X19,X20,
                X21,X22,X23,X24,X25,X26,X27,X28,X29,X30,
                X31,X32,X33,X34,X35,X36,X37,X38,X39,X40,
                X41,X42,X43,X44,X45,X46,X47,X48,X49,X50,
                X51,X52,X53,X54,X55,X56,X57,X58,X59,X60,
                X61,X62,X63,X64,X65,X66,X67,X68,X69,X70,
                X71,X72,X73,X74,X75,X76,X77,X78,X79,X80,
                X81,X82,X83,X84,X85,X86,X87,X88,X89,X90,
                X91,X92,X93,X94,X95,X96,X97,X98,X99,X100,
                X101,X102,X103,X104,X105,X106,X107,X108,
                X109,X110,X111,X112,X113,X114,X115,X116,
                X117,X118,X119,X120,X121,X122,X123,X124,
                X125,X126,X127,X128,X129,X130,X131,X132,
                X133,X134,X135,X136,137,X138,X139,X140,
                X141,X142,X143,X144,X145,X146,X147,148,
                X149,X150,X151,X152,X153,X154,X155,X156,
                X157,X158,X159,X160,X161,X162,X163,X164,
                X165,X166,X167,X168,X169,X170,X171,X172,
                X173,X174,X175,X176,X177,GROUP
                (F8.0,72F1.0 / 80F1.0 / 26F1.0)

SET            BLANKS = 9 / WIDTH = 80
MISSING VALUES SURVEYNO TO X177 (9)

T-TEST        GROUPS = grp (1,2) / VARIABLES = X3
T-TEST        GROUPS = grp (1,2) / VARIABLES = X6
T-TEST        GROUPS = grp (1,2) / VARIABLES = X9
T-TEST        GROUPS = grp (1,2) / VARIABLES = X12
T-TEST        GROUPS = grp (1,2) / VARIABLES = X15
T-TEST        GROUPS = grp (1,2) / VARIABLES = X18
T-TEST        GROUPS = grp (1,2) / VARIABLES = X21
T-TEST        GROUPS = grp (1,2) / VARIABLES = X24
T-TEST        GROUPS = grp (1,2) / VARIABLES = X27
T-TEST        GROUPS = grp (1,2) / VARIABLES = X30
T-TEST        GROUPS = grp (1,2) / VARIABLES = X33
T-TEST        GROUPS = grp (1,2) / VARIABLES = X36
T-TEST        GROUPS = grp (1,2) / VARIABLES = X39
T-TEST        GROUPS = grp (1,2) / VARIABLES = X42
T-TEST        GROUPS = grp (1,2) / VARIABLES = X45
T-TEST        GROUPS = grp (1,2) / VARIABLES = X48
T-TEST        GROUPS = grp (1,2) / VARIABLES = X51
T-TEST        GROUPS = grp (1,2) / VARIABLES = X54
T-TEST        GROUPS = grp (1,2) / VARIABLES = X57
T-TEST        GROUPS = grp (1,2) / VARIABLES = X60
T-TEST        GROUPS = grp (1,2) / VARIABLES = X63
T-TEST        GROUPS = grp (1,2) / VARIABLES = X66
```

T-TEST	GROUPS = grp (1,2) / VARIABLES = X69
T-TEST	GROUPS = grp (1,2) / VARIABLES = X72
T-TEST	GROUPS = grp (1,2) / VARIABLES = X75
T-TEST	GROUPS = grp (1,2) / VARIABLES = X78
T-TEST	GROUPS = grp (1,2) / VARIABLES = X81
T-TEST	GROUPS = grp (1,2) / VARIABLES = X84
T-TEST	GROUPS = grp (1,2) / VARIABLES = X87
T-TEST	GROUPS = grp (1,2) / VARIABLES = X90
T-TEST	GROUPS = grp (1,2) / VARIABLES = X93
T-TEST	GROUPS = grp (1,2) / VARIABLES = X96
T-TEST	GROUPS = grp (1,2) / VARIABLES = X99
T-TEST	GROUPS = grp (1,2) / VARIABLES = X102
T-TEST	GROUPS = grp (1,2) / VARIABLES = X105
T-TEST	GROUPS = grp (1,2) / VARIABLES = X108
T-TEST	GROUPS = grp (1,2) / VARIABLES = X111
T-TEST	GROUPS = grp (1,2) / VARIABLES = X114
T-TEST	GROUPS = grp (1,2) / VARIABLES = X117
T-TEST	GROUPS = grp (1,2) / VARIABLES = X120
T-TEST	GROUPS = grp (1,2) / VARIABLES = X123
T-TEST	GROUPS = grp (1,2) / VARIABLES = X126
T-TEST	GROUPS = grp (1,2) / VARIABLES = X129
T-TEST	GROUPS = grp (1,2) / VARIABLES = X132
T-TEST	GROUPS = grp (1,2) / VARIABLES = X135
T-TEST	GROUPS = grp (1,2) / VARIABLES = X138
T-TEST	GROUPS = grp (1,2) / VARIABLES = X141
T-TEST	GROUPS = grp (1,2) / VARIABLES = X144
T-TEST	GROUPS = grp (1,2) / VARIABLES = X147
T-TEST	GROUPS = grp (1,2) / VARIABLES = X150
T-TEST	GROUPS = grp (1,2) / VARIABLES = X153
T-TEST	GROUPS = grp (1,2) / VARIABLES = X156
T-TEST	GROUPS = grp (1,2) / VARIABLES = X159
T-TEST	GROUPS = grp (1,2) / VARIABLES = X162
T-TEST	GROUPS = grp (1,2) / VARIABLES = X165
T-TEST	GROUPS = grp (1,2) / VARIABLES = X168
T-TEST	GROUPS = grp (1,2) / VARIABLES = X171
T-TEST	GROUPS = grp (1,2) / VARIABLES = X174
T-TEST	GROUPS = grp (1,2) / VARIABLES = X177

### SAS Rank Order Correlation

```
options linesize=78;
data ranks;
input milrank civrank @@;
cards;
  1  1  2 20  3 17  4 15  5  9  6  6  7 14  8  3  9 24
10  5 11 28 12 40 13 35 14  7 15 27 16 16 17  2 18 11
19  4 20 29 21 33 22 23 23 39 24 30 25 10 26 43 27 38
28 45 29 41 30 25 31 52 32 26 33  8 34 12 35 18 36 31
37 21 38 22 29 13 40 51 41 34 42 19 43 47 44 42 45 46
46 50 47 48 48 32 49 36 50 49 51 54 52 37 53 56 54 44
55 53 56 55 57 57 58 58 59 59
;
proc cancorr data = ranks all;
var milrank; with civrank;
title 'educational skills ranked by importance';
title2 'military & civilian rank order correlation';
proc print;
```



## Bibliography

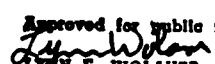
1. Air Force Institute of Technology. School of Systems and Logistics Annual Evaluation Report FY 85. Wright-Patterson Air Force Base OH, 1986.
2. Bell Communications Research Technical Education Center. 1987 Bellcore TEC Course Catalog. Product Promotion Group, Bell Communications Research, Inc., Lisle IL, December 1986.
3. Department of the Air Force. 1985 - 1987 Catalog. Air Force Institute of Technology. Wright-Patterson AFB OH, 1986.
4. Department of the Air Force. Civil Engineering General: Resource and Work Force Management. AFR 85-1. Washington: HQ USAF, 21 May 1982.
5. Department of the Air Force. Officer Personnel: Officer Classification. AFR 36-1. Washington: HQ USAF, 1 January 1984.
6. Devore, Jay L. Probability & Statistics for Engineers and the Sciences. Monterey CA: Brooks/Cole Publishing Company, 1982.
7. Dominowski, Roger L. Research Methods. Englewood Cliffs NJ: Prentice-Hall, Inc., 1980.
8. Donovan, John. "Plant Engineering at Digital Equipment Corporation," Plant Engineering, 40:28-33 (June 26, 1986).
9. Duncan, Captain Mike, Assistant Program Manager, Graduate Engineering Management. Personal interview. Air Force Institute of Technology, Wright-Patterson Air Force Base OH, 25 February 1987.
10. "Employee Training in America," Training and Development Journal, 39:34-37 (July 1986).
11. Freund, John E. Statistics: A First Course. Englewood Cliffs NJ: Prentice-Hall, Inc., 1970.
12. Gordan, Jack. "Where the Training Goes," Training, 23:49-63 (October 1986).
13. "A Guide for the Development of the Attitude and Opinion Survey," HQ USAF/ACM, Pentagon, Washington, DC, October, 1974.

14. International Facility Management Association (IFMA). Education Report, Facility Management Disciplines. IFMA Research Report, No 1. Arizona: IFMA Arizona Chapter, 1986.
15. Katzel, Jeanine. "Frito-Lay's Plant Engineering Strategy for the 1990s," Plant Engineering, 40:48-54 (August 28, 1986).
16. Klug, Thomas J., Marketing Manager. Personal interview. American Institute of Plant Engineers, Cincinnati OH, 20 February 1987.
17. Kocaoglu, Dundar F. "Engineering Management Education and Research," Paper Presented at the International Congress on Technology and Technology Exchange / Engineering Management Conference 84. 1-10+. 1984.
18. Porter, Lyman W. and Edward E. Lawler. Managerial Attitudes and Performance. Homewood, IL: R. D. Irwin, 1968.
19. Smith, J. Parke K., Captain, USAF, Personal Correspondence. Headquarters Air Force Military Personnel Center, Randolph Air Force Base TX, 20 February 1987.
20. "A Tale of Two Plants," Plant Engineering, 40:56-60 (11 September 1986).

## VITA

Captain David M. Kreag was born on 14 June 1959 in Peru, Indiana. He graduated from high school there in 1977, and attended Purdue University, from which he received a Bachelor of Science Degree in Industrial Engineering in December 1981. After graduation, Captain Kreag was commissioned in the United States Air Force through the Officer Training School at Medina Annex, Lackland AFB, Texas, on 26 August 1982. His initial assignment was to K. I. Sawyer AFB, Michigan, where he worked as Chief of Industrial Engineering, 410th Civil Engineering Squadron. In August 1984, he was assigned to the 6112th Civil Engineering Squadron at Misawa Air Base, Japan, which was changed to the 432nd Civil Engineering Squadron shortly thereafter. He was again assigned as Chief of Industrial Engineering in charge of implementing a prototype Work Information Management System minicomputer until entering the School of Systems and Logistics, Air Force Institute of Technology, in May 1986. Captain Kreag's next assignment will be at Wurtsmith AFB, Michigan.

Permanent address: R. R. 5 Box 315 A  
Peru, Indiana 46970

REPORT DOCUMENTATION PAGE				Form Approved OMB No. 0704-0188	
1a. REPORT SECURITY CLASSIFICATION <b>UNCLASSIFIED</b>			1b. RESTRICTIVE MARKINGS		
2a. SECURITY CLASSIFICATION AUTHORITY			3. DISTRIBUTION / AVAILABILITY OF REPORT <b>Approved for public release; distribution unlimited</b>		
2b. DECLASSIFICATION / DOWNGRADING SCHEDULE					
4. PERFORMING ORGANIZATION REPORT NUMBER(S) <b>AFIT/GEM/LSM/87S-14</b>			5. MONITORING ORGANIZATION REPORT NUMBER(S)		
6a. NAME OF PERFORMING ORGANIZATION School of Systems and Logistics		6b. OFFICE SYMBOL (If applicable) <b>AFIT/LSM</b>	7a. NAME OF MONITORING ORGANIZATION		
6c. ADDRESS (City, State, and ZIP Code) <b>Air Force Institute of Technology Wright-Patterson AFB OH 45433-6583</b>			7b. ADDRESS (City, State, and ZIP Code)		
8a. NAME OF FUNDING / SPONSORING ORGANIZATION		8b. OFFICE SYMBOL (If applicable)	9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER		
8c. ADDRESS (City, State, and ZIP Code)			10. SOURCE OF FUNDING NUMBERS		
			PROGRAM ELEMENT NO.	PROJECT NO.	TASK NO.
					WORK UNIT ACCESSION NO.
11. TITLE (Include Security Classification) <b>See Box 19</b>					
12. PERSONAL AUTHOR(S) <b>David M. Kreag, B.S., Captain, USAF</b>					
13a. TYPE OF REPORT <b>MS Thesis</b>		13b. TIME COVERED FROM _____ TO _____		14. DATE OF REPORT (Year, Month, Day) <b>1987 September</b>	
15. PAGE COUNT <b>112</b>					
16. SUPPLEMENTARY NOTATION					
17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)		
FIELD	GROUP	SUB-GROUP	<b>Education, Engineering, Facilities, Management</b>		
<b>13</b>	<b>08</b>				
19. ABSTRACT (Continue on reverse if necessary and identify by block number)					
<p><b>Title: AN INVESTIGATION OF EDUCATIONAL REQUIREMENTS IN FACILITIES ENGINEERING</b></p> <p><b>Thesis Chairman: Hal A. Rumsey, Major, USAF GEM Program Director</b></p>					
<p style="text-align: right;">Approved for public release: LAW AIR 130-16    <b>LYNN E. WOLAYER</b> 24 Sept 87            Dean for Research and Professional Development            Air Force Institute of Technology (AFIT)            Wright-Patterson AFB OH 45433</p>					
20. DISTRIBUTION / AVAILABILITY OF ABSTRACT <input checked="" type="checkbox"/> UNCLASSIFIED/UNLIMITED <input type="checkbox"/> SAME AS RPT. <input type="checkbox"/> DTIC USERS			21. ABSTRACT SECURITY CLASSIFICATION <b>UNCLASSIFIED</b>		
22a. NAME OF RESPONSIBLE INDIVIDUAL <b>Hal A. Rumsey, Major, USAF</b>			22b. TELEPHONE (Include Area Code) <b>(513) 255-5023</b>		22c. OFFICE SYMBOL <b>AFIT/LSM</b>

This research identified academic subjects considered important by facility managers in order to improve the Air Force's educational program on facility management. From the literature review, 59 academic subjects were incorporated into a survey to test for perceived need and importance. Two populations of facility managers were surveyed to compare military and civilian perspectives, using a 7-point Likert scale.

The results indicated that professional ethics was the single most important subject. Construction management, life cycle costing, leadership, technical writing, communication, statistical analysis, strategic planning, and public speaking were rated with means above 5 (important) by both military and civilian respondents. Seventeen other academic subjects were rated by either the military or civilian respondents as important. Of the 59 academic subjects, 35 (59 percent) showed no significant differences between the means of the military and the civilian respondents.

Twelve academic subjects not specifically included in the Air Force's Graduate Engineering Management curriculum were considered important by either the military or the civilian respondents: professional ethics, construction management, strategic planning, maintenance management, budget preparation, building fire protection, building programming, civil engineering, mechanical engineering, electrical engineering, safety engineering, and Value engineering. Inclusion of these academic subjects may improve the overall program. They could be incorporated into already existing courses, or made available as additional elective courses in the GEM curriculum.

END  
FILMED  
FEB. 1988  
DTIC